THE IRON TRADE REVIEW

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MORE CHEERFUL

IS THE FEELING IN THE PIG IRON MARKET.

Furnaces Made a Good Record Last Month.—Heavy Demand for Cotton Ties.—Coke Prices Decline.

The remarkable ability of the market to shake off temporary lethargy, which has been manifested several times during recent months, is again being shown and the feeling in the pig iron market is distinctly stronger, although prices show little if any change. Some additional information in regard to the sales of southern iron, aggregating 75,000 tons, reported last week, is now available, showing that the leading pipe interest bought 33,000 tons and indicating that other very large consumers may soon appear in the market. An electric interest is inquiring for 10,000 tons. Valley producers of Bessemer pig iron, who have only about 20,000 tons unsold for the first half of the year, have fixed the second quarter price at $22 furnace, and it is expected that the unsold tonnage will soon be disposed of. Large interests in the south are very firm in their prices, and, although some iron has been sold by brokers at less than the ordinary quotations, buyers are finding it very difficult to place orders at less than $18.50 Birmingham for last half delivery. Rumors of concessions on southern iron are not so frequently heard as they were a week or two ago.

Blast Furnace Production. Our monthly blast furnace statistics indicate an average daily production for February of 73,108 tons, against 70,155 tons in January, but a number of stacks were blown out during the closing days of last month, and it is expected that others will go out of commission for repairs this month. As the warm weather approaches, the difficulty of southern furnaces in obtaining labor increases.

Railroad Buying. The urgent demand of the railroads for delivery of rails is indicated by the action of the Carnegie Steel Co. in placing its combination mill at Youngstown on rails after operating it for some months on sheet bars. Among the noteworthy orders from railroads are one for plates for 1,000 steel cars which will be turned out at the Chicago plant of the Pressed Steel Car Co., 5,000 tons of bridge material for the New Haven railroad, and about 30,000 tons of steel rails. We are officially advised that an increase in freight rates, averaging 10 per cent on pig iron and all kinds of iron and steel products, will become effective June 1. An advance of 5 cents on coke in the Connellsville district will become effective April 15.

Cotton Tie Demand. The outlook is that the demand for cotton ties will be unprecedented this year. Nearly all of this material has been rolled, but the price has not yet been announced. The leading interest has not been able to improve the delivery of sheets, and independent companies are obtaining premiums of from $1 to $6 per ton for prompt delivery.

Coke is Lower. The blowing out of a number of furnaces for repairs has decreased the demand for coke, and prices of foundry coke show a sharp decline, sales having been made as low as $2.90. Prices of foundry grades are also somewhat lower. The scrap market shows improvement in some centers, but in other places buyers are apathetic.

The strike of machinists at the Toledo plant of the Pope-Toledo Motor Car Co. has been settled through the intervention of the city officials. The plant remains an open shop.

SOUTHERN DIFFICULTIES

Reflected in the Report of the Sloss-Sheffield Steel & Iron Co.

(Special Telegram.)

New York, March 13.—The annual report of the Sloss-Sheffield Steel & Iron Co., shows gross earnings for the year ending with November last as $6,290,0[illegible]. This is an increase of more than $500,000 over the previous year, but unusually heavy operating charges bring the net earnings down to $1,351,746, a decrease of over $200,000. A statement was also issued covering operations for the quarter ending with February last. It shows profits of $315,339, which is less than in the corresponding quarter of the two years previous.

Commenting on the report, President J. C. Maben states that the company made 30,000 tons less of iron than in 1905 and also produced less coal and coke. All of Alabama produced only 70,000 tons more iron than in the previous years. This he attributes in part to the scarcity of labor, but in larger degree to the inability of the railroads to handle raw materials and to deliver the iron. Furnaces of the company were frequently banked for want of coke when train loads were on sidings only a short haul away. The tendency to surround the railroads with legislative restrictions is deprecated as making it difficult for them to finance needed improvements.

MOLDERS ASK ADVANCE.

A conference between the Stove Founders' National Defense association and the Iron Molders' Union of North America will be held in Chicago beginning March 26. Representatives of each organization will met at the Auditorium hotel and the conference will probably last several days.

The principal question to be taken up will be the increase of wages demanded by the molders. They are now paid at the rate of 20 per cent on list prices. By their agreement with the employers' association they are compelled to give thirty days' notice of any demand for an increase. This notice was formally given Feb. 27.

THE WEEK IN IRON CENTERS.

PITTSBURG.

Pig Iron Market is Stronger.—Heavy Structural Specifications.

Office of THE IRON TRADE REVIEW, 521 PARK BUILDING, MAR. 13

Despite the absence of noteworthy transactions, the iron and steel market gained considerable strength during the week. The operation of the combination mill of the Carnegie Steel Co., Youngstown, on rails, having changed from sheet bars, reflects the growing demands of the railroads for early shipments, and is further refutation of the retrenchment reports. Structural fitters are likewise being urged by the steam roads to hurry forward material and up to the present no postponements or cancellations have been received. The structural mills of the Carnegie Steel Co. this week received specifications from the American Bridge Co. for 26,000 tons of material for rolling within the next sixty days, and plates for 1,000 steel cars were placed by the western plant of the Pressed Steel Car Co. Bessemer iron for the second quarter has been fixed at $22 furnace, and a careful estimate places the unsold tonnage of the valley stacks to July 1 at 29,000. Negotiations are now under way for the bulk of this tonnage, which, from present indications, will be disposed of before April 1. The idleness of a number of furnaces has thrown a large tonnage of coke on the market, sales having been made at $2.90. Contracts for foundry grades for the remainder of the year are being closed at $3.50 ovens.

Pig Iron.—Despite the limited buying of all grades of iron, the market gained strength during the past week. Valley producers of Bessemer have fixed the second quarter price on a basis of $22 furnace, and inasmuch as they have only 29,000 tons unsold until July 1, they are reasonably certain that this quotation can be maintained. Negotiations are already under way for the purchase of a large part of this tonnage, and whatever remains unsold at the end of this month will undoubtedly be taken by the Carnegie Steel Co. Before April 1 the iron from two additional Carrie furnaces will be available, amounting to 1,000 tons daily, and while this increased output will be sufficient to meet the growing steel works requirements, nevertheless repairs to other stacks, already outlined, will figure in maintaining the output close to the present total. The sale of 1,200 tons of Bessemer for prompt shipment has been reported at $22.85 Pittsburg, and one small lot brought $23.10. For immediate delivery No. 2 foundry is quoted at $24, furnace, and $23 is asked for second quarter. For spot malleable Bessemer, valley furnace, $22 is quoted, and a concession of 50 cents a ton is made for deliveries extending to July 1. Quotations for the second quarter follow:

Bessemer Valley	$ 22.00
Bessemer, Pittsburg	22.85
No. 1 Foundry, Pittsburg	24.35 to 24.85
No. 2 Foundry, Pittsburg	23.85 to 24.35
Gray Forge, Pittsburg	21.35 to 21.85
Basic, Valley	22.00 to 22.25
Basic, Pittsburg	22.85 to 23.10

Ferro-Manganese.—The demand is limited entirely to small lots for immediate requirements and carloads of 80 per cent sell at $75 Pittsburg, although as low as $73.50 has been done. For deliveries extending over the remainder of the year, $70 is quoted. There has been no change in the prices of ferro-silicon, imported continuing to be held at $110 for 50 per cent, and domestic, 12 per cent, $36; 11 per cent, $35; 10 per cent, $34.

Steel.—After operating on sheet bars for several months, the combination mill of the Carnegie Steel Co., Youngstown, has turned on rails, and the indications are that no bars will be rolled until the present insistent demands of the railroads have been satisfied. There have been no noteworthy transactions in steel, and quotations remain unchanged as follows: Sheet bars, $30 valley, and 4 x 4 billets and larger, either Bessemer or open-hearth, $29.50 to $30 Pittsburg.

Skelp.—The skelp market continues exceedingly quiet, as none of the mills has any surplus to offer. Quotations are unchanged as follows:

Bessemer, grooved, 1.80c to 1.85c; sheared, 1.75c to 1.80c; basic, grooved, 1.85c to 1.90c; sheared, 1.80c to 1.85c; iron skelp, sheared, 2.15c to 2.25c; grooved, 2c to 2.10c.

Muck Bar.—There has been practically no change in the situation, as mill offers are exceedingly light and the demands of most of the large consumers are being met by shipments on existing contracts. Quotations are nominally at $37.50 to $38 for all pig bars, and $36.75 for scrap bars.

Plates.—The Carnegie Steel Co. this week booked an order for plates for 1,000 steel cars which will be manufactured by the Chicago plant of the Pressed Steel Car Co. All of the local plate mills are operating at their capacity and specifications on mill order books from lake ship yards and steel car works cover the output for the next 60 days at least. Eastern mills continue to secure premiums of $2 to $4 a ton for immediate shipments, although official quotations are unchanged as follows:

Tank plate ¼-inch thick, 6¼ to 100 inches, 1.70c f. o. b. mill Pittsburg. Light plate schedule, No. 10, 1.80c; Nos. 11-12, 1.85c; Nos. 13-14, 1.90c; Nos. 15-16, 2c; extras on the regular plate schedule are as follows per 100 pounds: Boiler and flange steel plates 0.10c; A. B. M. A. and ordinary firebox steel plates, 0.20c; still bottom steel, 0.30c; marine steel, 0.40c; locomotive firebox steel, 0.50c; all sketches, excepting straight taper plates varying not more than four inches in width at ends, narrowest end not being less than 30 inches, 0.10c; complete circles, 0.20c. Plates in width over 100 inches up to 110 inches, 0.05c; over 110 inches up to 115 inches, 0.10c; over 115 inches up to 120 inches, 0.15c; over 120 inches up to 125 inches, 0.25c; over 125 inches up to 130 inches, 0.50c; over 130 inches, 1.00c. Gages under ¼-inch to and including 3-16-inch plates on thin edges, 0.10c; under 3-16 to and including No. 8, 0.15c; under No. 8 and including No. 9, 0.25c. Five cents extra for less than carloads. Terms, net cash in 30 days.

Sheets.—The recent rapid advances in spelter foreshadow higher prices for galvanized sheets, as present quotations fall considerably short of covering the increased cost of this material. For March or April shipment $8.50 is quoted and prompt is held at $6.90. So heavy are the accumulated mill specifications that none of the manufacturers is in position to make shipment before June. The premiums are still given on both black and galvanized and jobbers' stocks are reported very low. Mill quotations are as follows:

Black steel sheets, one pass, cold rolled; Nos. 11-12, 2.20c; Nos. 13-14, 2.25c; Nos. 15-16, 2.30c; Nos. 17-21, 2.35c; Nos. 22-24, 2.40c; Nos. 25-26, 2.45c; No. 27, 2.50c; No. 28, 2.60c; No. 29, 2.75c; No. 30, 2.85c; galvanized, Nos. 10-11, 2.65c; Nos. 12-14, 2.75c; Nos. 15-16, 2.85c; Nos. 17-21, 3.00c; Nos. 22-24, 3.15c; Nos. 25-26, 3.35c; No. 27, 3.55c; No. 28, 3.75c; No. 29, 4.00c; No. 30, 4.25c. Corrugated roofing, $1.85 per square for No. 28 painted, 2½-inch corrugation, and $3.25 per square No. 28 galvanized, 2½-inch corrugation. Blue annealed sheets, No. 10 and heavier, 1.85c; Nos. 11-12, 1.90c; Nos. 13-14, 1.95c; Nos. 15-16, 2.05c.

Tin Plate.—Actual specifications

now on the books of tin plate manufacturers cover their output until July and only occasional spot orders can be filled. Notwithstanding this difficulty, few premiums are being paid, the independents alone asking an advance of ten cents for third quarter delivery. Stocks at all of the tin mills are at a low ebb and there is practically no material on hand with which to meet the customary heavy spring demands. The report that additional mills will be added to the Shenango plant of the American Sheet & Tin Plate Co., New Castle, has been officially denied. No disposition has been made regarding the ultimate destination of the mills in the Star plant this city, which is to be dismantled. The buildings will be removed to Canton, O., where they will be used for much needed additions to the company's rolling plant at that place. The Humbert, Gas City and Anderson plants continue idle. The mills of the Standard Tin Plate Co., Canonsburg, Pa., are still inoperative, as the result of the strike of the Amalgamated Association, although the Washington, Pa., plant of the McClure Tin Plate Co., is reported to have materially increased its output despite the strike. Tin plate remains unchanged at $3.90 for 100-pound cokes.

Rails and Track Material.—Owing to the insistent demands of the railroads for early shipments of rails, the combination mill of the Carnegie Steel Co., Youngstown, which had been operating on sheet bars for some time, was again turned on rails this week. During the past year this plant has operated on sheet bars for only a few brief periods, and the indications are that rails will be rolled without interruption through the summer months. The light rail mills of the Carnegie Steel Co. are again operating in full as result of heavy orders recently placed. Quotations are unchanged as follows:

Fifty-pound and heavier, 500-ton lots and over, $28; carloads and less than 500 tons, $30; less than carload lots, $32; 8-pound, $40; 12-pound, $36 to $37; 16-pound, $35 to $36; 20-pound, $34 to $35; 25 to 45-pound, $33 to $34; angle splice bars for standard sections, $1.65; spikes for forward deliveries, $2.50.

Hoops, Bands and Cotton Ties.—While no date has yet been fixed for the opening of the cotton tie market, the naming of the price on this season's tonnage has already been considered. Practically all of this material has already been rolled and has gone forward to southern distributing points in barges by way of the Ohio and Mississippi rivers. Requirements this year promise to break all previous records, as the cotton yield, owing to the increased acreage planted, will undoubtedly exceed last year's total. We make the following quotations:

Hoops in carload lots, 2c; in less than carload lots, 2.10c; bands, 1.60c base, half extras as per standard steel.

Merchant Bars.—The committee appointed by the implement makers for the purpose of securing concessions on their 1907-1908 tonnage requirements has not yet called on any of the steel makers. The visit of this body, however, is awaited with considerable interest. Specifications for both iron and steel bars are heavy, but new business is limited entirely to car lots for immediate requirements. We quote:

Common iron bars, 1.80c Pittsburg in carload lots and over; 1.85c in less than carloads; Bessemer steel bars, 1.60c, net; plow and cultivator, 1.60c, net; channels, angles, zees, tees, under three inches, 1.70c, all f. o. b. Pittsburg. The following differentials are maintained on steel: Less than 2,000 pounds, 0.10c advance; less than 1,000 pounds of a size 0.30c advance. Cold rolled and ground shafting, 50 per cent off in carload lots, and 5 per cent off in less than carloads, delivered in base territory; open-hearth spring steel, 2.25c to 2.50c, sleigh shoe flats, 1.60c to 1.65c; smooth finished machinery steel, 1.90c to 2c; toe calk, 2.10c to 2.15c. The price of planished and machine straightened tire is 1.80c, base, half tire extras. Iron finished tire up to 1½ inch and over to be sold on regular bar basis of 1.60c base, half extras, steel card.

Structural Material.—The American Bridge Co. this week placed an order with the Carnegie Steel Co. for 26,000 tons of shapes for early rolling, this tonnage having accumulated during the past 30 days, the American Bridge Co. having booked practically 40,000 tons in this period. Structural fitting shops generally report that none of the railroads has yet cancelled contracts, notwithstanding alleged retrenchments. The McClintic-Marshall Construction Co. has received orders for approximately 1,000 tons of material from the Pennsylvania railroad and the Central Railroad of New Jersey. Quotations remain unchanged as follows:

Beams and channels 15-inch, and under, 1.70c; over 15 inches, 1.80c; zees, 1.70c; tees, 1.70c; angles from three to six inches inclusive, 1.70c; over six inches, 1.80c; universal and sheared plates, 6¼ inches and wider, 1.70c base.

Wire and Wire Nails.—The demand for wire nails has reached abnormal proportions, most of the mills being from four to six weeks behind in their deliveries. So heavy were the requirements of jobbers during the winter months that few of the manufacturers were able to accumulate stocks for the spring trade, while shipments are again being prorated to meet the needs of the greatest number. An early advance not only on wire nails but wire products generally is anticipated, some of the independent mills already asking premiums for prompt deliveries. Quotations are unchanged as follows:

Wire nails, jobbers' carload lots, $2; retailers' carload lots, $2.05; less than carloads $2.10; painted barb wire, $2.15, for jobbers in carloads; retailers in carloads, $2.20; and less than carloads, $2.30 with 30c for galvanizing; plain wire $1.85 for jobbers and $1.90 by carload.

Merchant Pipe.—The demands from jobbers throughout the country whose stocks are practically depleted are insistent, and the specifications that are being daily received are in excess of mill capacity. The spring demand which has already set in promises to break all records in the pipe trade, and the production will fall far below the consumptive requirements. Discounts to consumers in car lots are unchanged as follows:

	Steel black	Steel galv.
⅛ to ¼ inch	66	50
⅜ inch	68	54
½ inch	70	58
¾ to 6 inches	74	64
7 to 12 inches	69	54
EXTRA STRONG PLAIN ENDS.		
⅛ to ¼ inch	59	47
⅜ to 4 inches	66	54
4½ to 8 inches	62	50
Double extra strong plain ends, ¼ to 8 inches	55	44

Boiler Tubes.—So far as new tonnage is concerned the market continues apparently quiet, although the mills are operating at their capacity on specifications from jobbers and locomotive works. We quote:

Boiler tubes.	Steel	Iron
1 to 1½ inches	47	47
1¾ to 2¼ inches	50	42
2½ inches	61	42
2¾ to 5 inches	65	52
2½ to 13 inches	59	42

Less than carloads two points less.
2½ inches and smaller, over 18 feet, 10 per cent, net, extra.
¾ inches and larger, over 22 feet, 10 per cent, net extra.

Coke.—Both furnace and foundry grades are weaker and prices have again declined. The open weather has enabled the railroads to move the stock accumulations of both the Connellsville and Klondike and at most of the valley furnaces the yards are congested with cars that have not been unloaded. Several iron producers are withholding shipping instructions and as a result the tonnage of spot coke that has been thrown on the market is heavier than at any time in the past six months. Sales have been made at $2.90 a ton, although as high as $3.10 to $3.15 has been paid. Foundry grades have been sympathetically effected and are held at $3.50 to jobbers, and $3.65 to $3.75 to consumers. During the month of

February the average price of Connellsville coke was $3.14 on sliding scale contracts made at the ratio of seven to one.

Old Material.—Local steel works have been buying all grades of scrap suitable for open-hearth practice during the week, the purchases easily aggregating 10,000 tons. This movement has undoubtedly been accentuated by the high prices prevailing for Bessemer and basic iron, making it more economical for the mills to increase their percentage of old material. Selected heavy stock continues to be quoted at $18, although an advance of 50 cents has been paid for very desirable material. At Steubenville the embargo has not yet been lifted by the mills, while at Sharon shipments cannot be received from one road. Despite this situation the market has evidently suffered no embarrassment, as the following quotations are being well maintained:

Heavy melting scrap, $18 to $18.50; rerolling rails, $20.50 to $21; bundled sheet scrap, $16.50 to $16.75; iron axles, $30.50 to $31; old iron rails, $23 to $23.50; No. 1 wrought scrap, $19.50 to $20; old car wheels, $24 to $24.50; low phosphorus scrap, $22.50 to $23; machine shop turnings, $15.50 to $16; axle turnings, $16 to $16.50; cast borings, $13 to $13.25; No. 1 cast scrap, $20 to $20.50.

CHICAGO.

Stronger Sentiment in Pig Iron.—Sales by Southern Furnaces.

Office of THE IRON TRADE REVIEW, 1963 MONADNOCK BLOCK, Mar. 12

A quiet week has passed in iron and steel. New tonnage and specifications keep their heavy pace. Shipments from mills are slow, especially of galvanized material, the production of which is now attended with difficulty owing to the higher cost and scarcity of spelter. Pig iron is sentimentally stronger, but without change in price. There is a fair demand for spot iron, but very little inquiry is felt from western foundries for the last half. Some large transactions have been consummated with southern furnaces in other markets, however, among the recent buyers being the United States Cast Iron Pipe & Foundry Co., which took 33,000 tons for the last half.

No new developments have transpired in connection with the steel bar purchases by the implement interests other than that mills reiterate their determination to stand by the present schedule. Cast scrap has been in strong demand by Pittsburg consumers, a round tonnage having been moved from the west on the basis of $21 for No. 1 machinery cast, $16.50 for stove plate and $9.35 for borings.

An announcement of interest to the trade is made by the International Harvester Co. of the organization of the Wisconsin Steel Co., a subsidiary corporation, to take over and operate its properties consisting of blast furnaces, steel plants, rolling mills, ore mines and coal lands. All unfinished business pertaining to the above properties will be completed by the new company.

Pig Iron.—The market has perceptibly strengthened under the heavy buying of valley and southern irons during the past 10 days. These purchases, which include 33,000 tons for the United States Cast Iron Pipe & Foundry Co., a part of which is for delivery in the second quarter, have removed all but the remnants of the tonnage that was held in reserve to meet unforseen contingencies, and there is today a strong feeling of confidence among sellers that no further concessions will follow. Improvement as a result of these changed conditions is noted in other sections, but no change in values has occurred on the local market. Southern No. 2 foundry for the last half can still be obtained as low as $18 Birmingham, and for the second quarter at $21, while for immediate delivery the price ranges from $22 to $23 Birmingham, according to the shipment. Northern irons nominally rest on the basis of $23.50 Chicago for No. 2 foundry, but there has been so little buying for several weeks that it is hard to tell just what could be done on a round tonnage.

Lake Superior charcoal is without change in value, the firmly sold up conditions of most furnaces enabling the maintenance of present values without difficulty. Our quotations below are for the last half, southern prices being on the basis of a $4.10 freight rate.

Lake Superior charcoal	$25.50 to 26.50
Northern Foundry No. 1	24.00 to 24.50
Northern Foundry No. 2	23.50 to 24.00
Northern Foundry No. 3	23.00 to 23.50
Northern Scotch Foundry	24.00 to 24.50
Ohio Strong Softeners No. 1	23.30 to 23.80
Ohio Strong Softeners No. 2	22.80 to 23.30
Southern Foundry No. 1	22.60 to 23.10
Southern Foundry No. 2	22.10 to 22.60
Southern Foundry No. 3	21.60 to 22.10
Southern Foundry No. 4	21.10 to 21.60
Southern No. 1 Soft	22.60 to 23.10
Southern No. 2 Soft	22.10 to 22.60
Southern Gray Forge	19.60 to 21.10
Southern Mottled	19.10 to 19.60
Southern Silveries 4 per cent to 6 per cent Silicon	24.60 to 25.10
Jackson Co. Silveries, 8 to 10 per cent Silicon	30.30 to 32.30
Malleable Bessemer	23.50 to 24.00

Billets and Rods.—No change in the crude steel situation is noticed. Material seems plentiful for all current requirements, mills in Buffalo and Philadelphia offering their surplus tonnage in this market. Prices continue firm at $36 to $38 Chicago for forging billets, according to tonnage and delivery, and $36 Pittsburg for Bessemer rods.

Iron and Steel Bars.—No further developments have transpired with reference to the pending purchase of steel bars by implement interests for the year commencing July 1. The concessions last year led to many unexpected complications, and the steel producers reiterate their determination to stand "pat" on the present schedule this year. Specifications continue exceedingly heavy, and every mill is behind in deliveries. Practically all the season contracts placed last spring are within 15 per cent of completion, and new contracts cannot much longer be postponed. Bar iron shows no change either in price or movement. The local market is firm on the basis of 1.65c Pittsburg. We quote as follows:

Hard steel angles, 1.75c; soft steel bars and bands, 1.76½c. half extras; soft steel angles less than 3 x 3, 1.86½c; hoops, 2.16½c base, full extras. We quote bar iron from stock 2.25c, full extras; soft steel rounds and squares, 3 inches and larger, $2 per 100 pounds base; flats, 2 inches to 4 inches by 1⅛ inch and larger, $2 per 100 pounds base; 4½ inches x 5 inches and 6 inches x 5-16 inch and thicker, $2 per 100 pounds base; all ovals, half rounds, $2 per 100 pounds base, steel bands, $2, half extras; soft steel hoops, 2.40c to 2.50c, full extras. Other sizes not mentioned above, $2 per 100 pounds base plus half extras.

Plates.—Mills have almost given up hope of overtaking the delinquent tonnage for sheared and universal plates. Except from independent producers delivery within four months of either product cannot be secured, and those interests that can make prompt shipments are asking 1.80c to 1.85c Pittsburg. General prices are without change as follows:

Plates ¼ inch and thicker 6⅛ to 100 inches wide, either universal or sheared, 1.70c Pittsburg base. For extras, see Pittsburg report. Freight rate to Chicago, 16½c per 100 pounds. Jobbers' prices for shipment from local stocks are as follows: Tank steel ¼ inch and heavier up to 72 inches wide, 2.20c; 3-16 inch up to and including 60 inches wide, 2.30c; 3-16 inch 72 inches wide, 2.55c; No. 8 up to 60 inches wide, 2.35c. Flange steel, 25c extra; heads, 25c extra.

Sheets.—Deliveries from mills are very slow. Consumers cannot always secure relief from jobbers, as warehouse stocks also are low, and in many instances jobbers have had to pay stiff prices to replenish same. New tonnage keeps up remarkably well. Prices are firm, especially on galvanized material on which an advance is early expected as a result of the high cost of spelter. We quote carload lots as follows:

Black sheets Nos. 8, 9 and 10, 1.90c Pittsburg; No. 28 gage, 2.60c Pittsburg. Galvanized sheets No. 28 gage, 3.75c Pittsburg. Freight to Chicago 16½c per 100 pounds. Jobbers' prices on less than carload lots from store are as follows:

No. 10, 2.25c to 2.30c; No. 12, 2.30c to 2.35c; No. 14, 2.35c to 2.40c; No. 16, 2.45c to 2.50c; Nos. 18-20, 2.70c to 2.80c; Nos. 22-24, 2.75c to 2.85c; No. 26, 2.80c to 2.90c; No. 27, 2.85c to 2.95c; No. 28, 2.95c to 3.05c; No. 30, 3.35c. Galvanized sheets, Nos. 10 to 20, 3.40c to 3.45c; Nos. 22 and 24, 3.55c to 3.60c; No. 26, 3.75c to 3.80c; No. 27, 3.95c to 4c; No. 28, 4.15c to 4.20c; No. 30, 5.35c to 5.40c.

Structural Steel.—Contracts for the Spreckles and Phalen buildings in San Francisco, calling for 2,000 and 1,000 tons of steel shapes, respectively, have been let to the American Bridge Co. The only local development of interest is the passage of an ordinance by the Chicago city council authorizing the demolition of the present city hall and the construction of a new building to match the county building now under construction. The latter building consumed in the neighborhood of 11,000 tons of shapes, and it is expected that the city hall will require an equal tonnage. The movement of shapes from mills and warehouses shows an improvement over recent weeks, and indications point to a continuation of this increased tonnage. Prices are without change as follows:

Beams and channels, 3 to 15 inches inclusive, 1.70c Pittsburg. For extras see Pittsburg report. Freight rate from that city to Chicago is 16½c per 100 pounds. Quotations from store are as follows:

All angles, three inches and larger, including six inches, $2.05 to $2.10 per 100 pounds; angles over six inches, $2.15 per 100 pounds base, beams, three inches to 15 inches, inclusive, $2.05 to $2.10 per 100 pounds base; channels, three inches and larger, $2.05 per 100 pounds base. Less than carload lots are $1 a ton higher than foregoing prices.

Rails and Track Supplies.—Little of interest has developed in the week under review. Some good sized inquiries for standard sections are being shopped around in hope of securing desirable deliveries, but thus far they have not been placed. Light rails continue in good demand, but as the best delivery obtainable is three months from date, new tonnage is small. We quote as follows:

Bessemer rails, $28 to $30; less than 500-ton lots, $32; open-hearth rails, $29; light rails, Bessemer, 30 to 45-pound sections, $35; 25-pound, $36; 20-pound, $37; 16-pound, $38; 12-pound, $39, and lighter sections down to 8-pound, $45.50, all f. o. b. mill. Track supplies vary in price according to quantity and delivery. Angle bars in large lots are quoted 1.65c to 1.75c; for smaller quantities, 2.25c to 2.75c; spikes, large lots, 2.30c; for smaller quantities, 2.50c; bolts, large lots, 2.65c to 2.75c; smaller lots, 2.85c with square nuts, and 3c with hexagon nuts.

Merchant Steel.—Consumers continue to press manufacturers hard for deliveries, but he enormous tonnage on the books of the latter and the constant stream of specifications prevent any notable improvement in this respect. Prices are as follows:

Planished or smooth finished tire steel, 1.96½c; iron finish, up to 1½ x ½ inch, 1.91½c base; iron finish, 1½ x ½ inch and larger, 1.76½c base; channels for solid rubber tires, ¾ to 1 inch, 2.26½c, and 1⅛ inch and larger 2.16½c; smooth finished machinery steel, 2.16½c; flat sleigh shoe, 1.81½c; concave and convex sleigh shoe, 2.06½c; cutter shoe, 2.35c; toe calk steel, 2.31½c; railway spring, 1.96½c; crucible tool steel, 6½c to 8c, with higher prices asked on special grades. Shafting is very strong. Quotations are without change at 50 per cent off in car lots and 45 per cent in less than car lots in base territory.

Cast Iron Pipe.—The demand for pipe from municipalities and private companies is without diminution. No contracts of any moment have been placed in the past week, but the aggregate of small orders for betterments and extensions makes up a good sized tonnage. Prices for Chicago delivery are without change as follows: Four-inch water pipe, $38.60; six to 12-inch inclusive, $37.60; 16-inch and upward, $1 a ton less; gas pipe, $1 a ton higher.

Merchant Pipe.—Consumers are bending their efforts to replenish depleted storage stocks before the spring rush is felt in its full force. Deliveries, however, are slow, and complicated by a scarcity of raw material as well as of cars. Prices are firm but without change. We quote ¾ to six inches black steel pipe, 74.35 per cent discount; galvanized 64.35 per cent discount. From store in small lots, Chicago distributors are asking 72½ per cent discount on the base sizes.

Boiler Tubes.—No cessation is noted in the movement for tubes. Deliveries are improving, but are not yet up-to-date. Prices are firm as follows: 2¾ to five inches, steel, 63.35 per cent discount; iron, 50.35; seamless, 50.35. On less than carload lots from store, we quote 60 off for steel; 47½ for iron and 47½ for seamless.

Wire Products.—Spring orders for wire materials are coming in with a rush. Mill facilities for production and shipment have increased in the past few weeks, and delinquent deliveries are rapidly being overtaken. Manufacturers are complaining of the scarcity and high cost of spelter, and an advance in galvanized wire materials is desired by some interests. We quote prices to jobbers, Chicago delivery, as follows:

Wire nails, $2.15; painted barb wire, $2.30; galvanized barbed wire, $2.60; smooth annealed wire, $2.30; polished staples, $2.55. Carload lots to retailers, five cents higher; less than carload lots, 15 cents higher.

Coke.—The mild weather this month has been unusually favorable to coke production and shipments, and prices are easier in consequence. We quote Connellsville 72-hour brands for spot delivery at $3.60 to $3.75 ovens, and on contracts for forward shipments at $3.50. By-product is without change at previous quotations.

Old Material.—The local market has been in an apathetic state all week. The demand for cast scrap, so sharp a week ago, has entirely subsided, and the only movement of material now in progress is on orders of Pittsburg consumers. Several new railroad lists were promulgated this week, including one of 6,000 tons, by the B. & O.; 1,100 tons by the C., R. I. & P.; 900 tons by the C. & E. I., and a good sized list by the Great Northern railway. We quote as follows, gross tons in the first paragraph:

Old Steel Rails (3 feet and over)	$19.00 to 19.50
Old Steel Rails (less than 3 feet)	18.00 to 18.50
Old Car Wheels	24.00 to 24.50
Old Iron Rails	25.00 to 26.00
Light Section Relayers 45 lbs. and under, subject to inspection	30.00 to 32.00
Relaying Rails, subject to inspection	31.00 to 32.00
Frogs, Switches and Guards	16.50 to 17.00
Heavy Melting Steel	16.00 to 16.50
Mixed Country Steel	12.50 to 13.00

We quote net tons as follows:

No. 1 R. R. Wrought	$15.25 to 15.75
No. 2 R. R. Wrought	14.25 to 14.50
Shafting	17.00 to 17.50
Dealers Forge No. 1	12.00 to 12.50
Wrought Pipe and Flues	12.00 to 12.50
No. 1 Cast, 150 pounds and less	19.00 to 20.00
No. 1 Mill	10.00 to 10.50
Mixed Busheling (No. 1 & No. 2)	11.00 to 11.50
Country Sheet	8.50 to 9.00
No. 1 Boilers Cut	11.50 to 12.00
Boiler Punchings	15.00 to 16.00
Iron Car Axles	26.50 to 27.00
Steel Car Axles	21.00 to 21.50
Iron Axle Turnings	11.50 to 12.00
Cast Borings	9.25 to 9.75
Mixed Borings, etc	9.25 to 9.75
Machine Shop Turnings	11.50 to 12.00
Railroad Malleable	16.00 to 16.00
Agricultural Malleable	15.00 to 15.50
Stove Plate and Light Cast Scrap	15.00 to 15.50
Old Iron Splice Bars	20.00 to 21.50

CLEVELAND.

Foundrymen Urging Deliveries of Pig.—Cleaning Up the Docks.

Office of THE IRON TRADE REVIEW, Browning Building, Mar. 12

Iron Ore.—Some furnace interests which find that they will be well supplied with ore until after the opening of navigation are disposing of some of their supply on dock to furnaces not so well provided, and the outlook is that the movement from dock to furnaces will be very heavy during the next 30 days, so that the amount on dock at the opening of navigation will be small. The ice at the Soo is very heavy and the prospect is that the boats will not be able to pass through as early as they did last year.

Pig Iron.—Foundrymen are pressing furnaces hard for deliveries on contracts and it is evident that many of them need all the iron bought as soon as it

can be delivered to them. Buying is not active, but the market is firm. Rumors of weakness in the southern market are usually traceable to brokers or consumers who are anxious to buy. An indication of the strength of the market is cited in the fact that in the trading of coke for pig iron the ratio of 6 to 1, which formerly prevailed, has been abandoned, now seven tons of coke are given for one of pig iron by brokers. We quote, f. o. b. Cleveland for last half, as follows:

Bessemer	$21.00 to 21.50
No. 1 Foundry	22.50
No. 2 Foundry	22.00
No. 3 Foundry	21.50
No. 2 Southern	22.60
Gray Forge	20.00 to 20.50

Coke.—Owing to weather conditions being favorable for a large output and to the inactivity of a number of furnaces which are being repaired, the prices of furnace coke for prompt delivery are lower, ranging from $3 to $3.15. For last half delivery, prices range from $3.15 to $3.25. Foundry coke is selling at $3.50 to $3.75.

Finished Material.—There are no indications that the mills will recede from their determination not to make any concessions this year to agricultural implement interests on steel bars. In some cases last year the concession of $2 per ton was made to concerns taking a very small tonnage. For example, a manufacturer of incubators using about 50 tons per year was granted the low price. This policy caused a great deal of dissatisfaction among the more important buyers. Deliveries of finished products do not show much improvement and independent sheet mills are able to obtain premiums from $1 to $6 per ton for prompt shipment. A little better delivery on plates is noticeable. Jobbers report a good demand for structural material out of store, and the jobbing business in all lines is good.

Old Material.—Sufficient business continues to sustain prices generally at present levels. There is no more activity in buying by the mills than there has been in the past. The United States Steel Corporation, after being out of the market for some time, however, has reappeared as a buyer of scrap, both directly from local dealers and through non-resident brokers. The buying, from the standpoint of individual dealers, is not heavy. The B. & O. railroad is seeking bids from dealers on a list of upwards of 5,000 tons, and the Southern railway on a lot of 3,000 tons. Turnings and borings remain in good demand. There has been an advance in stove plate, but as the season is approaching when large tonnages in this grade will be on the market, the present price is regarded as the height of the market.

Our revised quotations, f. o. b. Cleveland, gross tons, are as follows:

Old iron rails	$25.00 to 26.00
Old steel rails (re-rolling)	18.50 to 19.50
Old steel rails (under 6 feet)	18.50 to 19.50
Old car wheels	23.00 to 23.50
Steel boiler plate	13.50 to 14.00
Steel axles	21.50 to 22.50
Malleable iron (railroad)	18.50 to 19.00
Malleable iron (agricultural)	15.50 to 16.00
Heavy steel	17.00 to 17.50
Country mixed steel	14.50 to 15.50
Low Phosphorus	23.00 to 24.00

We quote net tons as follows:

No. 1 R. R. wrought	$17.00 to 18.00
No. 1 busheling	14.50 to 15.00
No. 1 machine cast	18.00 to 18.50
Iron axles	25.50 to 26.00
Axle turnings	13.50 to 14.00
Wrought turnings (free from cast)	13.00 to 13.50
Grate bars	14.00 to 15.00
Pipes and flues	13.50 to 14.00
Tank iron	12.00 to 13.00
Hoop and band iron	8.50 to 9.00
Sheet iron	7.50 to 8.50
Wrought drillings	13.00 to 13.50
Stove plate	15.00 to 15.50
Cast borings	10.50 to 11.00

CINCINNATI.

Business in Pig Iron Light and Prices Show No Change.

March 11.

Pig Iron.—The week has developed but little change in the market conditions. Business is quiet and there is a light inquiry and the few requests for prices are for small tonnages. There is a slight improvement in the movement of iron from the south, but not to an extent that could be called relief and much of the correspondence in the offices concerns delayed shipments.

Prices remain on the same level as last week. Spot southern iron in transit is held at $23 Birmingham and sales are mainly on this basis. Northern iron for prompt shipment is scarce and quoted at $25 at furnace for No. 2 foundry. We quote spot iron delivered Cincinnati as a basis for settling contracts based on our quotations as follows:

Southern foundry No. 1	$26.50
Southern foundry No. 2	26.00
Southern foundry No. 3	25.00
Southern foundry No. 4	23.50
Southern foundry, No. 1 soft	26.50
Southern foundry, No. 2 soft	26.00
Gray forge	$21.50 to 22.00
Northern foundry No. 1	26.65 to 27.75
Northern foundry No 2	26.15 to 27.15
Northern foundry No. 3	25.65 to 26.65
Jackson County silvery, 8 per cent	31.15

Second quarter iron is quiet with southern brands quoted at $21 to $21.50 Birmingham, and northern scarce at $23.00 for No. 2 at furnace.

Last half delivery southern iron is well maintained at $18.50 Birmingham and northern iron appears to be a shade stronger with most furnaces holding for $21.50 for No. 2 at furnace although it is currently believed that $21 can be done. The trade seems to be of the opinion that there is a strong undertone to the market in spite of the present quiet conditions. A number of stacks in the central western territory will blow out in the next sixty days for relining and general repairs. Five have already advised interested persons as to their inability to continue operations much longer and several more are on the verge of blowing out. As the spring season advances, labor in the south becomes difficult to obtain. These features are pointed out as factors in keeping production from reaching maximum in the next two months. We quote for last half delivery, delivered Cincinnati as follows:

Southern Foundry No. 1	$22.00 to 22.50
Southern Foundry No. 2	21.50 to 22.00
Southern Foundry No. 3	21.00 to 21.50
Southern Foundry No. 4	20.50 to 21.00
Southern Foundry No. 1, soft	22.00 to 22.50
Southern Foundry No. 2, soft	21.50 to 22.00
Gray Forge	19.50 to 20.50
Northern Foundry No. 1	22.65 to 23.15
Northern Foundry No. 2	22.15 to 22.65
Northern Foundry No. 3	21.65 to 22.15
Jackson County Silvery, 8 per cent	30.15 to 31.15

Coke.—The market rules quiet with a moderate demand for prompt shipment coke and there is a slightly easier feeling in the market although prices are quotably lower. Prices in the leading coke producing centers are as follows f. o. b. ovens:

Wise County, Va. Furnace Coke prompt shipment	$3.25 to 3.50 per ton
Wise County, Va. Foundry Coke	4.00 to 4.25 per ton
Pocahontas Furnace Coke prompt shipment	3.25 to 3.50 per ton
Pocahontas Foundry Coke	3.50 to 4.00 per ton
Connellsville Furnace Coke prompt shipment	3.25 to 3.60 per ton
Connellsville Foundry Coke	4.00 to 4.25 per ton
New River Foundry Coke on contracts	3.75 to 4.00 per ton
New River Furnace Coke, prompt shipment	2.75 to 3.00 per ton

†Wise County, Va., Coke on Furnace contracts is sold mainly on a sliding scale basis for pig iron prices on the following basis: $1.70 to $1.75 per ton on $9.00 pig iron, plus 19 to 20 per cent of the advance on pig iron above $9.00 Birmingham.

Old Material.—The market rules quiet with an easy tone, but there was no quotable change in price. We quote:

Old No. 1 railroad wrought, net tons	$17.50 to 18.50
Cast machine and foundry, net tons	18.50 to 19.00
Old iron rails, gross tons	25.50 to 26.50
Old steel rails, gross tons	19.00 to 20.00
Old short lengths, gross tons	18.00 to 19.00
Old iron axles, net tons	26.00 to 26.50
Heavy melting scrap, gross ton	20.00 to 21.00
Stove plate, net tons	14.50 to 15.00
Wrought turnings, net tons	12.50 to 13.00
Cast borings, net tons	9.50 to 10.00
Car wheels, gross tons	21.50 to 22.00

Finished Material.—The market rules firm and jobbers are holding well to price lists on small lots. Specifications on contracts are good. Retail orders are filled here at the following prices:

Angles 3 x3 and over, 2.15c to 2.25c; beams and channels 15 inches and under, 2.15c; small angles and architectural channels, 2.10c base; plates ¼ inch and heavier, 2.10c base; plates ¼ inch and heavier, 2.10c; 3-16 inch, 2.20c; No. 8, 2.20c; sheets (blue annealed) No. 10, 2.30c; No. 12, 2.35c; No. 14, 2.40c; No. 16, 2.50c; box annealed sheets, Nos. 18 and 20, 2.65c; Nos. 22 and 24,, 2.75c; Nos. 25 and 26, 2.80c; No. 27, 2.85c; and No. 28, 2.95c.

Iron and steel bars, 2.00 base; boiler tubes, 60 per cent off base; turn buckles, 45 per cent off; rivets, 3.15c base; cold rolled shafting, 45 per cent off list; steel tire, 2.10c base.

PHILADELPHIA.

Large Purchase of English Iron.—Pig Iron Market is Strong.

March 12.

Pig Iron.—Second quarter requirements still constitute the bulk of the market, which continues absolutely firm and strong. Recent developments, such as the United States Steel Corporation's purchases of Bessemer iron, the strengthening in the price of southern irons and the announcement of approaching increases by the railroads on both raw materials and finished steel products have all tended to confirm producers in the position they have taken as to maintaining prices, and from present indications there is no likelihood of any concessions before July 1. For the last half the buying is still comparatively light, owing to the diversity of views as to the future. The pessimistic opinions advanced in Wall street find no support among furnace men, and they believe that, as the middle of the year grows nearer, prices will steadily approximate toward those now ruling. Large purchases of English iron have been made for March and April deliveries at this port, and while this continues to arrive, no marked advance in prices is looked for, despite the great scarcity of domestic irons for prompt delivery. There have been no notably large sales during the past week, but the volume of small sales for spot or second quarter shipment makes a large aggregate. Prices for the third quarter have stiffened somewhat, and those for second quarter command handsome premiums, varying with the circumstances of nearly every sale. There is a considerable range in the prices asked for third and fourth quarters, which may be quoted about as follows:

No. IX Foundry	$25.75 to 26.25
No. 2X Foundry	23.50 to 24.50
No. 2 Plain	23.25 to 23.75
Standard Gray Forge	22.25 to 22.75
Basic	23.50 to 24.25
Low Phosphorus	27.00 to 27.50

New Material.—Without particularizing on the strength of various finished products, it may be said that all lines as reported here are strong, and that the mills have business assured them for several months ahead. Prices remain at the figures previously quoted: Beams, channels and angles, according to specifications, 1.83½c to 2c; refined iron bars, 1.89½c to 1.93½c; steel bars, 1.83½c to 1.88½c; plates, 2.13½c to 2.18½c.

Old Material.—There is a trifle more activity in some lines of scrap, with a little advance in prices, but the market shows more of the buoyancy that prevails in pig iron and finished products. Prices are firmly held, however, for an advance that is expected before long. For the present they may be quoted as follows:

Old steel rails	$19.50 to 20.00
No. 1 steel scrap	18.75 to 19.25
Old steel axles	22.00 to 22.50
Old iron axles	30.00 to 31.00
Old iron rails	27.00 to 27.50
Old car wheels	23.00 to 24.00
Choice scrap, R. R. No. 1 wrought	20.75 to 21.25
No. 1 yard scrap	18.75 to 19.25
Machinery scrap	22.50 to 23.00
Low phosphorus scrap	22.50 to 23.00
Wrought iron pipe	16.50 to 17.00
No. 1 forge fire scrap	16.50 to 17.00
No 2 forge fire scrap, ordinary	11.50 to 12.00
Wrought turnings	16.75 to 17.25
Axle turnings, heavy	17.25 to 17.75
Cast borings	15.00 to 15.50
Stove Plates	17.00 to 17.50

NEW YORK.

Improvement in Pig Iron.—Frisco Buying.—Strike of Stove Molders Feared.

Office of THE IRON TRADE REVIEW.
ROOM 1315, No. 150 NASSAU ST., MAR. 12

Pig Iron.—The week has witnessed a marked improvement in inquiry on the local market. The first ten days of March were productive of only a moderate volume of new business, but the present week opened with a number of concerns in the market for good tonnages, and this, coupled with the unplaced inquiries current during the past week, makes it apparent that the early future is to develop conisderable purchasing. Spot iron is particularly active, with several producers out of the market and prices exceedingly firm. The unsold portions of several cargoes of British iron recently arriving were readily disposed of, it is stated, at about $22.00, duty paid, and no anxiety is now manifested over the disposition of later importations. In this connection it is interesting to note that one southern producer has advanced its Alabama irons for spot delivery $1.00 a ton, but this figure is expected to apply only on business in the southern district, transportation difficulties still working against any early shipments into this territory. In a way, the southern car shortage has lent strength to the local situation for some months past by enabling the importers of British iron to dispose of it as a substitute for delayed Georgia and Alabama brands, thereby keeping the spot market free of accumulations of foreign iron. For the second quarter and later delivery, there is also increased inquiry, though it can not be said that any extensive buying movement is in sight. The level of prices is well maintained, however, and one Pennsylvania interest has advanced its last half quotations fifty cents. It now seems probable that July 1 will see an advance of 5 per cent in all northern freight rates; certain selling interests are now closing contracts with provision for this emergency. There is considerable talk in iron circles of the threatened strike of stove molders in the east, as it is expected that if this takes place it will be bitterly contested and may be extended to other branches of the molding industry, thereby exerting an important influence on pig iron markets. Owing to the closing down of a number of furnaces, the coke situation is remarkably easy. Spot Connellsville is procurable at $3.00 ovens and Virginia at $2.75. We quote second half tidewater prices as follows:

Northern Foundry No. 1	$24.00 to 25.00
No. 2 Foundry	23.50 to 24.50
No. 2 Plain	23.00 to 24.00
No. 1 Southern Foundry	22.50 to 23.00
No. 2 Southern Foundry	22.00 to 23.00
No. 3 Southern Foundry	21.50 to 22.00
No. 4 Southern Foundry	21.00 to 22.00

Finished Materials.—San Francisco is appearing as a frequent though moderate purchaser of structural materials. Contracts have been closed for 1,400 tons for the Grant building in that city and for 1,000 tons for the foundation of the Phelan building, both going to the American Bridge Co. This interest has also taken 1,000 tons for a building at Springfield, Mass., 400 tons of bridge work for the Chicago, Lake Shore & Eastern and 700 tons for a highway bridge in Minnesota. The New Haven has let about 5,000 tons of bridge materials to the Pennsylvania Steel Co. the Pennsylvania has divided 700 tons among various producers and the Philadelphia & Reading has closed for 200 tons. The Great Northern and Tidewater requirements and other scattered railroad work involving a total of 10,000 tons are as yet unfilled.

The feature of the bar iron market is the extremely heavy specifying. In some instances contracts running through the first quarter have been completely exhausted and specifications have been continued in the absence of a further contract, though mills have refused to accede to such an arrangement. A good inquiry is reported and no decline from present prices is anticipated. As soon as consuming interests become satisfied of this, a considerable buying movement is expected. The plate market is quiet, with active specifications. One large inquiry, reported last week, is still pending.

The following are prices at tidewater: Angles 3 to 6 inches x ¼ inch and heavier, 1.84½c; beams, 3 to 15 inches, 1.84½c; tees, 3 x ¼ inch and heavier, 1.89½c; plates, carloads, tank, 1.94½c; flange, 1.94½c; marine boiler, 2.14½c; refined iron bars, 1.84½c to 1.89½c; soft steel bars, 1.74½c to 1.84½c; sheets, No. 28 black, 2.60c.

Old Material.—The strength of heavy cast scrap continues the feature of the market, with prices firm.

Wrought scrap is not in active demand, but heavy steel is strong. A number of large railway lists have closed during the week and awards will be announced within a few days. We quote local prices on gross tons as follows:

Old iron rails	$24 00 to 25.00
Old steel rails, long lengths	19.50 to 20.00
Old steel rails, short pieces	16.50 to 17.00
Relaying rails	28.00 to 29.00
Old car wheels	21.50 to 22.00
Old iron car axles	28.50 to 29.50
Old steel car axles	21.00 to 21.50
Heavy melting steel scrap	16.25 to 16.75
No. 1 railroad wrought scrap	20.00 to 20.50
Iron track scrap	17.50 to 18.00
Wrought pipe	14.50 to 15.00
Cast borings	12.00 to 12.30
Wrought turnings	14.50 to 15.00
Heavy Cast Scrap	19.00 to 19.50
Railroad Malleable	18.00 to 18.50
Agricultural Malleable	16.00 to 17.00
Stove Plate	16.50 to 17.00

BUFFALO.

Market is Strong and Higher Prices of Pig Iron are Probable.

March 11.

Pig Iron.—The market in the Buffalo district during the past week has been characterized by very little selling and a strong tone. There were many inquiries and few contracts for delivery. Those made were for delivery during the last quarter. Prices have remained unchanged and all the rumors emanating from the east have in no way depressed the condition so far as prices are concerned. From the producer's standpoint the market is satisfactory and it is felt that good prices and a strong market will prevail for some time, if not indefinitely.

A study of the general market continues to be made here with much interest. There is naturally plenty of speculation as to the future, but those who are in a position to know about what is to be expected have their minds pretty well made up that the strong market has come to stay and that before prices go down again they will go higher. The past week has been the most quiet period of the month closed. This lull cannot last long. Consumers must have iron and some say they are holding off too long. Seldom has iron been bought up so far ahead as it is now and furnaces may not be able to operate at their full capacity indefinitely.

It is not improbable that certain furnaces, which have been operated for many months under a severe strain, will need to be relined. This can be done more advantageously in warm weather. If this condition comes, and consumers who have not bought fully on account of hoping for lower prices come into the market for early deliveries, and railroads place orders for greatly needed equipment, it is likely that pig iron will materially advance in price. While there are many indications that these things may come about, it is not the condition that many desire and probably many will try to avert it.

The impression seems to be quite general that the railroads cannot curtail their improvement expenses very much this year. All shippers know that facilities are inadequate. So far as iron men are concerned, they have, both producer and consumer, been hampered for want of cars. The congestion of freight and shortage of cars, affecting seriously many points, have been injurious to business in Buffalo. At almost any time this winter, shipments of iron out of Buffalo were delayed from one to three weeks, while shipments due here from Tennessee furnaces in December have not yet arrived. This peculiar and remarkable condition indicates that the railroads cannot afford to do without new equipment and the conclusion here is that it can be but a short time before they will be in the market for equipment calling for vast quantities of iron.

For last half delivery we quote as follows:

No. 1 X Foundry	$22.75 to 23.25
No. 2 X Foundry	22.25 to 22.75
No. 3 Foundry	21.50 to 22.00
No. 2 Plain	22.00 to 22.50
Malleable Bessemer	22.50 to 23.00
Gray Forge	21.50 to 22.00
Charcoal	26.00 to 27.00

ST. LOUIS.

Both Buyers and Sellers Inactive.—Sales in Small Lots.

March 11.

Pig Iron.—Conditions are somewhat easier in the pig iron market, though prices have not suffered any severe slump. There has simply developed a wider range in all deliveries, owing to the attitude of hesitancy assumed by buyers in general and the desire of some few furnaces to book a few orders for future delivery. The shading of prices comes, in the main, from the smaller furnaces. The leading producers are holding off the market, either believing confidently in the future, or (as seems more probable) they are refusing to sell, knowing that they will thus create a shortage and send prices up. At any rate, it appears that both sides are jockeying for position with the chances in favor of the furnace men until deliveries become more prompt.

For the last week, spot has been selling at $22.50 to $23 on the basis of Birmingham No. 2, whereas $23 has been the quotation for weeks. Second quarter is quoted from $21 to $21.50 and last half from $18 to $18.50. One leading interest is holding for $19, but is booking no business.

The leading southern producer has notified its agents that it is oversold thousands of tons for first half and it is not desirous of booking orders yet for second half. Consequently the local agent is lying low. On the other hand the buyer for the largest consumer in this market has withdrawn his inquiries for quite a large tonnage and announces that he will not buy anything until September except a few lots for current delivery. He is satisfied the market will take a dip in the near future.

Sales during the week were of the small lot order for immediate consumption. The American Car bought 4,000 tons of southern soft and some malleable.

Our quotations for last half, including the new freight rate of $3.75 range as follows:

Southern No. 1	$21.75 to 22.25
Southern No. 2	21.25 to 21.75
Southern No. 3	20.75 to 21.25
Southern No. 4	20.25 to 20.75
Gray Forge	19.25 to 20.25

Coke.—Coke can be bought liberally at $3.90 for any delivery. Tonnages booked during the week were moderate.

BIRMINGHAM, ALA.

Spot Iron Selling at Higher Prices—Delivery Improves.

March 11.

Pig iron selling continues briskly in the southern territory according to the reports given out by the manufacturers. Spot iron, delivery within the month, sold in small lots here the last few days at $24 per ton, No. 2 foundry. This product, though scarce, has been quoted for several weeks at $23 per ton. Only smaller manufacturers have been selling the spot iron, there being a fascination in the business for the 100 and 125-ton a day makers. The advance of one dollar per ton for the spot iron was quite significant. Sales of iron for delivery during the latter part of the year have been made with steadiness during the past week, and the product commands $18.50 and $19 per ton, No. 2 foundry, basis, the latter price being the most generally quoted. The furnace companies are still showing perfect ease as to prospects for the entire year and intimation is given already that there will be buying after the second quarter for 1908 iron.

Two furnaces are to go into operation by the end of this month, one at Rising Fawn, Ga., belonging to the Southern Steel Co., and the other at Anniston, belonging to the Woodstock Iron Co. The Sloss-Sheffield Steel & Iron Co. and the Tennessee Coal, Iron & Railroad Co. expect to get furnaces in at Florence, Bessemer and Birmingham in the next few weeks, a large force of men being at work on the iron-makers. The preparations for the raw material supplies are still being pushed, the organization

of a new ore mining company being announced during the past week. The larger iron companies in this district are working hard to improve the output at ore mines and limestone quarries so as to care for the increased iron production.

BRITISH MARKET

Easily Influenced by American Conditions.

Office of THE IRON TRADE REVIEW.
Prince's Chambers, Corporation St.,
Birmingham, Eng., March 1.

The course of events during the past week have again demonstrated that the pig-iron market is supremely sensitive to American influences. The least suggestion of American laxity has sufficed to depress warrants; while, on the other hand, news of an advance at once tones up the market. Today's report is a case in point. Yesterday the pig-iron warrant market was strong as the result of a reported advance in northern iron in America, with the result that Cleveland pig-iron changed hands up to £2-15-7d ($13.60) cash, and £2-15-11½d ($13.69) one month, closing at 1s to 1s 1½d higher than on Friday. The business totaled 15,000 tons. Warrants in the stores are still steadily reducing.

METAL MARKET.

CHICAGO.

March 12.

General dullness has characterized the metal market for the past week. None of the railroads have been in the market for large orders and other trades have been unimportant. No falling off in prices resulted, the general business conditions keeping the prices at the level of the past two weeks.

Copper sold at 26¾c for casting and 27c for lake. Pig tin varied between 44½c and 45c according to the quantity bought. Sheet zinc was quoted at 8.50c La Salle in car lots of 600-pound casks. Spelter sold for 6.90c. Lead desilverized sold between 6.50c and 6.60c for 50-ton lots and corroding at 7.25c to 7.35c. Carload lots were quoted 2½c per 100 pounds higher. For Cookson's antimony, 28½c was asked and other grades sold for 26½c.

Old metals show an unusually strong movement. Dealers' buying prices are as follows: Copper wire, 21½c; heavy copper, 21c; copper bottoms, 20c; copper clips, 20c; red brass, 20c; yellow brass, heavy 16c; yellow brass borings, 15c; red brass borings, 17½c; light brass, 13¼c; pipe lead, 5.25c; tea lead, 4¾c; zinc, 4¾c; tinfoil, 33c; pewter, No. 1, 25c.

NEW YORK.

March 12.

Copper.—The market is appreciably stronger, with an increasing demand and the probability that the western outturn in the near future will be lighter than had been expected. Slightly higher prices prevail, both in this country and abroad, with some important transactions reported. Electrolytic for April delivery is quoted at 25⅝c in large amounts, with nearby slightly above this figure. Lake copper is held at 26c to 26½c, according to date of delivery, while a recent sale of March copper for export was at 26⅝c. The London market closed yesterday at £110 7s 6d best selected bringing £118, a gain of £2 during the week. For the first 10 days of March exports from Atlantic ports were 4,231 tons.

Pig Tin.—Slightly lower prices prevailed at the beginning of the week and some few sales of spot tin were made at 42c to 42.10c. An easier tone also prevailed in London, where the Straits were offering March and April shipments at £192 15s. March arrivals total 2,060 tons, with 2,745 tons afloat.

Pig Lead.—An increased demand for immediate requirements is noted and the market is firm at 6.25c to 6.35c. Consumption is extremely heavy. Soft Missouri is held at 6.10c and soft Spanish closed Monday on the London market at £20.

Spelter.—Refined is quoted at 6.85c to 6.90c for spot shipments in car load lots. The London close yesterday was £26 2s 6d, the same as the week previous.

Antimony.—A quiet market prevails. Hallett's is held at 23c to 24c, Cookson's at 24½c to 25c, and ordinary brands at 22½c to 23c.

ST. LOUIS.

March 11.

Lead is firm, $6.05 to $6.07½ is offered, but is held at $6.10.

Spelter offerings were light. Spot metal is scarce, being held at $6.75 to $6.77½.

There was a tendency to weakness in the zinc ore market in the Missouri-Kansas field during the earlier part of the week, but strength developed at the end because spelter became stronger. There are 8,000 tons of ore in the bins, accumulated because of the car shortage, and buyers tried to use this to hammer down the market, but it developed that 7,000 were under contract and prices rose.

The Reading railway has awarded to George W. Beard & Co., Reading, Pa., the contract for the erection of a large car repair shop at Rutherford, near Harrisburg, Pa. The shop will accommodate 60 freight cars and will be one of the most modern car repair shops.

COPPER COMPANIES FIGHT

And Imperil Other Industries.—Bill Recalled by the Legislature.

During the past week the mining interests of Michigan have been considerably agitated by an attempt to put through some special legislation relative to one company voting the stock of other companies in which interests have been acquired. It is understood that an attempt has been made by eastern interests owning copper mines in the northern peninsula to prevent the expansion of controls held by the Calumet & Hecla Mining Co., the particular bearing being in reference to the control of the Osceola mine, of which the Calumet & Hecla Mining Co. now owns considerable stock and over which it is about to assume entire control.

While on the surface this seems to be nothing more than a fight between two copper interests for control of both the political and mining situation in the upper peninsula, the situation really affects all other mining, both iron and copper, as well as industrial companies which have for convenience' sake operated their various subsidiary interests through smaller subsidiary companies. There is possible, however, a radical distinction between the purpose of the two similar methods of operation, and the application of such legislation to them, because of the fact that in one case the attempt is made to create a monopoly by securing stocks and then voting them through the one company, and in the other case simply a convenient method of handling varied interests. Large interests, which for a great many years have been organized under such plans and which would be seriously affected by the proposed legislation, appealed to the governor to veto the measure which had been submitted to him, but by special action the bill was recalled by the legislature for further consideration. The distinction between the legislation now existing and which went into effect about two years ago, giving to mining companies permission to secure stock in other companies, and the legislation now proposed, is that, even though stock should be so secured, the company in which that interest was obtained must still be operated as a separate company.

LATE NEW YORK NEWS.

New York, March 13.—The following rail sales are announced; Kansas City, Mexico and Orient, 21,500 to the leading interest, Delaware and Hudson, 3,000 additional; scattering, 4,000.

An electric company is in the market for 10,000 tons of iron for last half.

PEACE AND PROSPERITY

Prevail in the Metal Trades in Cincinnati—Annual Dinner.

The annual meeting and dinner of the Cincinnati Branch of the National Metal Trades Association was held at the Hotel Sinton on the evening of March 7. The meeting was largely attended. Reports of standing committees and officers were read. The affairs of the association were shown to be in excellent condition. Arrangements were completed for a good representation at the coming convention of the National Association in Boston, and about 25 members will go in a body.

Owing to the great success of the outing given last year to the employes of the members of the association, it was decided to give another outing this year, some time during the summer.

Resolutions were adopted on the death of Harry C. Hoefinghof, who was a member of the executive committee, and a tribute was paid to his memory by S. P. Egan.

Secretary John M. Manley read an interesting report of the year's business. This branch takes credit for the cooperative plan of education now in operation between the University of Cincinnati and the shops of the machine tool manufacturers.

Isadore Rauh, chairman of the membership committee, reported an increase in membership during the year of 25 per cent, making the total membership now 71 concerns in this vicinity.

General trade conditions in the machine tool line were reported good. The shops have about the normal supply of men. The peaceful condition was a matter of satisfaction.

P. G. March, who has been the president of the local branch for the past two years, presided at the meeting. Before taking up the matter of election of officers for the coming year, he thanked the officers, committees and members for their loyal support and assistance during the time he had the honor of being the presiding officer. The following officers were elected for the ensuing year: S. P. Egan, of the J. A. Fay & Egan Co., president; J. W. Neil, of the McGowan Pump Co., vice president; E. M. Chase of the Cincinnati Milling Machine Co., treasurer; E. H. Hargrave of the Cincinnati Tool Co., secretary; George Langen of the Cincinnati Planer Co., Henry Ritter of the Lunkenheimer Co., and Isadore Rauh of the Cincinnati Electrical Tool Co., executive committee.

FREIGHT RATES

Advanced on Iron and Steel Products, Coke and Coal.—Effective June 1.

An increase in the freight rates averaging 10 per cent on pig iron and all kinds of iron and steel products, will go into effect in the iron and steel districts June 1. The increase was determined at a meeting of the freight managers of the various lines in Pittsburg recently, and it will be practically general in its effect throughout the iron producing districts. The increase in the various products will be varied, but as a whole it will average about 10 per cent.

In addition an advance of 5 cents a ton on all coke in the Connellsville district has been announced by the roads which deal in this traffic. This new tariff will go into effect April 15. A general increase in rates on coal in the middle west has likewise been determined upon by the carriers in that section of the country. The new rate will be a raise of 5 cents a ton on lake cargo and lake fuel, and 7½ cents a ton on railroad fuel, both effective April 15.

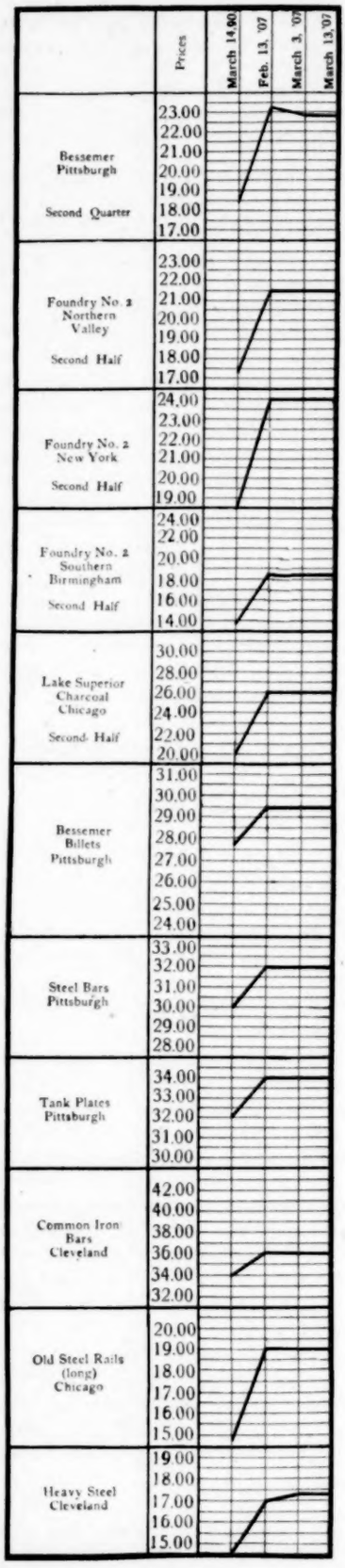
The railroads say the increase is an effort on their part to cope with the increased operating expenses.

HIGHER WAGES

Will be Given Both Union and Non-Union Tin Plate Workers.

As a result of the bi-monthly wage adjustment, the tin plate workers affiliated with the Amalgamated Association of Iron, Steel and Tin Plate workers will receive another advance of 2 per cent, during the months of March and April, a similar increase having been made the first of the year. The American Sheet & Tin Plate Co., adhering to the policy outlined on Jan. 1, will likewise advance the wages of its non-union men who, until the former advance in the tin plate scale, never shared the benefits of this wage adjustment. The tin plate scale is based on the selling price of coke plates at $3.40 per 100-pound box and the advance of 2 per cent is made for each increase of 10 cents in the selling price. As this is the second advance this year, the average selling price during January and February is between $3.60 and $3.70. The wages of the sheet workers remain unchanged, as they are based on an average selling price of $2.30 for 26-27-28 gage sheets, and to secure an increase of 2.6 per cent, the average selling price must advance to $2.40 or over. The examination of the bar iron sheets showed an average below 1.6c per pound, and the wages of the puddlers will remain at $5.75 per ton.

PRICE CHART.


Prices
March 14,'07
Feb. 13, '07
March 3, '03
March 13,'07
Bessemer Pittsburgh Second Quarter
23.00 22.00 21.00 20.00 19.00 18.00 17.00
Foundry No. 2 Northern Valley Second Half
23.00 22.00 21.00 20.00 19.00 18.00 17.00
Foundry No. 2 New York Second Half
24.00 23.00 22.00 21.00 20.00 19.00
Foundry No. 2 Southern Birmingham Second Half
24.00 22.00 20.00 18.00 16.00 14.00
Lake Superior Charcoal Chicago Second Half
30.00 28.00 26.00 24.00 22.00 20.00
Bessemer Billets Pittsburgh
31.00 30.00 29.00 28.00 27.00 26.00 25.00 24.00
Steel Bars Pittsburgh
33.00 32.00 31.00 30.00 29.00 28.00
Tank Plates Pittsburgh
34.00 33.00 32.00 31.00 30.00
Common Iron Bars Cleveland
42.00 40.00 38.00 36.00 34.00 32.00
Old Steel Rails (long) Chicago
20.00 19.00 18.00 17.00 16.00 15.00
Heavy Steel Cleveland
19.00 18.00 17.00 16.00 15.00

STEEL TIES

Are Satisfactory, Says Manager of Bessemer & Lake Erie.—Annual Report.

"Steel ties continue to give satisfactory results and confidence grows in their efficiency," says General Manager F. H. Utley of the Bessemer & Lake Erie Railroad Co., in discussing the affairs of the road in connection with the annual report for the fiscal year ended Dec. 1, 1906. "There were delivered during the year 1906 105,000 of these ties, a majority of which have been placed in the track. For new work and renewals for 1907, orders have been placed for 140,000 steel ties, which, when received together with those bought in 1906, will be equivalent to 92 miles of steel cross ties in track.

"The tonnage increased 965,000 tons, of which 134,030 tons were ore and 660,363 tons were coal. The percentage of northbound tonnage increased 3.61 per cent and stood for the year 33.59 per cent of the total, so that we have arrived at a point where empty mileage north is in a great measure done away with. The average train load for the year was 998 tons, an increase of 61 tons over the previous year."

The total income account of the road's business in 1906 compares with the previous year as follows:

Earnings—	1906.	1905.	Increase.
Freight	$5,552,466	$4,998,613	$553,853
Passenger	294,787	263,436	31,351
Mail & express	28,754	27,186	1,568
Miscellaneous	134,758	118,456	16,302
Total	$6,010,765	$5,407,691	$603,074
Expenses—			
Maint. way and struct.	$688,158	$585,120	$103,038
Maint. & equip.	772,088	667,731	104,357
Conduct. trans.	1,486,039	1,305,561	180,478
Gen'l. expenses	85,042	90,685	*5,643
Total	$3,031,327	$2,649,097	$382,230
Net earnings	$2,979,438	$2,758,594	$220,844

*Decrease

The company has declared the regular semi-annual dividend of 2½ per cent on the common stock, payable April 1.

STRIKERS WANT TO RETURN.

The efforts to establish an open-shop system among the foundries at Buffalo have been so successful that the union officers have decided to resort to new methods to obtain results favorable to the union. One of the latest moves they have made consisted in an effort by the molders' national president to secure the consent of the president of the Buffalo local to open negotiations with the foundrymen. This the national president readily secured and the proposition was made to the foundrymen that the striking molders be allowed to return to work with the independent men. In many cases the foundrymen have already been asked to take back the strikers.

GOVERNMENT WORK

In the Navy Not Satisfactory—Large Appropriations.

Washington, March 11.—A careful scanning of the naval appropriation bill as it finally passed the senate and was signed by the president reveals that it carried more for new construction than was anticipated when the measure made its first appearance in the house. All of the amendments with one exception, which were proposed by the senate, were adopted in the conference committee.

The bill provided for the construction of one new battle ship and two torpedo boat distroyers. An appropriation was also provided for the construction of the battle ship authorized last year, and an increase in the allowance for three torpedo boat distroyers authorized in last session's bill. Each of these torpedo destroyers is now to cost $800,000.

The two battle ships, the construction of which will begin as soon as the contracts can be let, will cost about $6,000,000, for the hull and machinery, exclusive of the armor and armament.

These vessels are to be the equal of any afloat, of 20,000 tons displacement.

The total for "increase of the navy" was $22,713,915; of this amount $3,000,000 was added in the senate to the allowance for armor and armament. In addition to these amounts for increase of the navy the bill authorized the modernizing of the batteries on the Iowa, Monterey, and Brooklyn, and appropriates $4,000,000 for reserve ammunition.

The question of a navy versus private builders seems to have been pretty well settled, as all the ships authorized by this bill are to be contracted for with private builders except in the event of collusion among bidders, which shall prevent free competition. An effort was made to have at least part of the new construction given to the government navy yards, but congress seemed to have learned a lesson from the building of the Connecticut and the Louisiana. The Connecticut was built at the navy yard in New York, and cost about $125,000, more than the Louisana, built by a private company, and was about three months behind in point of time.

This competition in construction has resulted in a serious check to the ambition of the navy department, to monopalize the supply of its material not only in forging and armor, but in other lines. Of course the avowed intention is to place the department beyond the influence of monoply, but the result of equipping the government department to do all its own work, would drive private plants out of business and really increase the cost of building a navy more than any private combination.

LARGEST EARNINGS

In History of Railway Steel Spring Co. are Shown During 1906.

The largest earnings in the history of the company are reported by the Railway Steel Spring Co. for the year ending Dec. 31, 1906, and President French is optimistic in his belief that present business conditions in the concern will continue. He reports that the company's works are now well filled up for the larger part of 1907. At the annual meeting the retiring board of directors was re-elected with the exception of George G. McMurtry, who was chosen in the place of Charles Scott Jr., resigned. The income account of the company for the year ended Dec. 31, 1906, compares as follows:

	1906.	1905.	1904.
Net earnings for year	$2,341,120	$1,949,993	$1,089,943
Less account Latrobe Plant purchase	450,000	.....	.....
Balance	$1,891,120	$1,949,993	$1,089,943
Less int. on Latrobe 5 per cent bonds	215,587	.....	.....
Net surplus for year	$1,675,533	$1,949,993	$1,089,943
Pref. divs.....	944,979	944,977	944,970
Balance	*$730,554	$1,005,016	$144,973
Prev. surplus...	2,045,899	1,580,871	1,705,886
Total surplus.	$2,776,453	$2,585,887	$1,850,859
Common divs...	539,988	539,988	269,988
Profit and loss surplus	$2,236,465	$2,045,899	$1,580,871

SHIP BUILDERS STRIKE.

A strike has been declared by the International Ship Builders' and Boilermakers' union against the American Ship Building Co., the workmen demanding a nine-hour day and a universal scale of wages along the chain of the great lakes. About 4,000 members of the union have joined in the strike, and many of the points where the American Ship Building Co. has its building yards or dry docks have been affected. Among the yards where the union employes have responded to the strike order are those at Cleveland, Lorain, Buffalo, Detroit, Ecorse, St. Clair, West Superior and Wyandotte. Employes who have ceased work are the calkers, fitters, riveters, helpers, drillers and boilermakers. The men at the Chicago yards were the last to comply with the orders of the strike leaders to lay down their tools. If the strike continues, some shipping interests of the great lakes may suffer severely, as the work on many new freighters, package freighters, passenger steamships and tugs in the course of erection may be delayed.

The Southern Railway Co. has begun work on the new shop buildings at Columbus, Miss. A warehouse and general storeroom building, followed by an office building and roundhouse, will be erected.

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PREVENTION OF INJURY.

The *American Federationist's* leading article last month, entitled "The Industrial Scrap Heap" summarizes clearly and forcibly the great personal injury and loss of life which accompany our present industrial system. The writer maintains that every year about 575,000 persons are killed or injured in the United States, 15 per cent of the number, or more than 75,000, being killed. The article presents a striking picture of present conditions, but contains no fresh suggestion of remedy. The exhibitions of protective devices for machinery and the establishment of a permanent museum are commended, and it is remarked that labor leaders and the press are more strongly urging additional legislation.

While the figures presented are doubtless sufficiently accurate to command respect, the bare citation of them is liable to create an exaggerated conception of the individual risk, through failure to show how greatly the casualties are distributed It is estimated in the article that 29,000,000 wage earners are involved, so that it can be deduced that a wage-earner is injured for every 60 years of service, and killed for every 400 years. Railroad employes suffer more than the average, as it may be observed that the Interstate Commerce Commission reports one injury per year for every nine men employed, and one death for every 120 employed.

It is quite true, as the article says, that the price is a high one to pay for our remarkable industrial progress, but the price is not necessarily high in a relative sense, if the results could not otherwise be obtained, because this industrial progress has saved many times the number of lives it has sacrificed, and the same may be said of personal injury, setting it against the injuries which would be wrought by a lack of personal comforts.

It is no less a duty, however, to strive to reduce the injury and loss of life. Good work is being done by some individual employers, and by those who are endeavoring to bring to more general notice protective devices. Unfortunately too much trust is placed in the passage of new laws. Perhaps there is a little too much regret expressed that the government has no right of appeal in the two cases in which the federal employers' liability act has been declared unconstitutional, as the idea has gained force that legislation should be had immediately by the several states.

The present is no situation upon which to build a mass of legislation. A problem is undoubtedly presented, but the conditions are not sufficiently understood. There is abuse even of the common law idea, which assumes that the employe in taking service bargains for the necessary risk, yet gives him the right to demand pecuniary compensation from his employer in some cases. The right thus given, and given in other cases by legislative enactment, has been woefully abused. To give the injured employe the right of redress through suit is a poor way of protecting him. He is usually in no condition to prosecute a suit, while the employer is driven, by the knowledge of many unjust decisions and the misapplication of damages when paid, to make a strenuous defense. The evil is one which should find better and more direct means of reduction than merely placing before the employer the chance of his losing a court case and being compelled to pay. Besides, the case of the railroads shows how inadequate is this form of legal redress. The railroad is much more at a disadvantage than would be the employer, who may stand very high in the community, yet it is far from certain that the railroads are forced to pay as they should for all casualties. They do, however, have to pay large sums, yet this has not acted as a sufficient preventive.

Less thought is being given than should be to the problem, increasingly difficult, of negligence by fellow workmen. The exploitation of protective devices is doing effective work. Legislation to increase the protection would be better than legislation assessing money damages.

THE RELATION OF EDUCATION TO SUCCESS.

In an article in *The Valve World* of January, 1907, R. T. Crane makes an attack on the value of technical education for young man in the shop. In the opinion of Mr. Crane the time spent in technical schools in the attempt to produce mechanics is, so far as manufacturing is concerned, not only absolutely wasted, but is a positive drawback. He states that "the great trouble with technical schools appears to be that they make a boy feel that he is getting a knowledge of things there which are essential to his success, and he is, therefore, superior to the boy who is brought up in the shop, and if he goes into a shop, he goes with his head swelled to such an extent that he is unable to grasp the sound, practical things that are essential to success. . . . . The boy who is going to make progress in his mechanical education must be thoroughly wide awake while working in the shop, should observe all the mechanical features by which he is surrounded and get a thorough understanding of them, studying them over and spending all his leisure time in seeking more information in that way. He can acquire

a fund of knowledge which, if he advances to a higher position, will be valuable to him, but, if he does not show any interest or energy in this direction, he will, of course, turn out to be but little different from the machine on which he has been working."

Mr. Crane has evidently had experience only with technical graduates of a few weeks or months experience. The average technical graduate by the time he has held a job after graduation for five or six months realizes his own limitations and the really small extent of his knowledge. The swelled head, if he ever possessed one, promptly disappears and he becomes a young man of the class indicated in the second section of the above quotation, and his advancement is then rapid. Mr. Crane, when he states in the same article that a young man who goes into the shop at the time he would naturally enter school will become much more of a success than if he acquired an education, takes a position far different from that of many men who have made a close study of the subject. James M. Dodge, in his presidential address before the American Society of Mechanical Engineers in 1903, prepared a table showing, as he called it, "The Money Value of Training." The facts in this table were obtained from the records, extending over a long period of years, of the men in the employ of Mr. Dodge's own company, one of the largest manufacturing enterprises in Philadelphia. Mr. Dodge showed that of two boys entering at the age of 16, one the shop and the other a trade school, each spending four years in learning the trade, the advancement of the school trained young man is much more rapid; that at the age of 25 his income amounts to $22 per week and is steadily rising, while that of the shop trained man is stationary at a little over $15 per week. The man trained in a technical school, at the age of 25 has the same income as the young man from the trade school, and one year later, he receives $4.50 per week more than the trade school man, and $12 more than the shop trained man. The increase in his income, and, therefore, in his value to the world, from this time is much more rapid than that of either the trade school or the shop trained man. These are not the figures of a theorist, but of the head of an eminently successful engineering and business establishment.

Another instance of the value of technical training is presented in a recent issue of *The Ohio State Lantern*, the weekly of the Ohio State University. In a random group of 25 technical graduates of that institution, of the average age of 28, a majority, however, being from the ceramics department, the average income was $2,257 per year, with a maximum of $7,500. We doubt very much whether Mr. Crane could pick at random 25 shop-trained men from his establishment or any other who, at an average age of 28, could show an average income of $2,250 per year, or anywhere near that figure.

Mr. Crane also contends that there are no difficult problems to be solved in a shop by the methods employed by a technical graduate. In answer to this we have only to point to Fred W. Taylor's monumental paper on "The Art of Cutting Metals," which is being reprinted at the present time in the columns of this journal. Mr. Taylor is a technical graduate, and it was while acting as foreman in a shop that he discovered the necessity of solving the problem of how to obtain the greatest amount of work of which a man and a machine were capable. The solution of this problem has occupied Mr. Taylor and a host of highly trained associates for over 26 years, and they are just beginning to see the end of their labors. The work is of the utmost importance to manufacturers and workers in metal, and would have been impossible of accomplishment by men not possessed of the highest technical training. Mr. Crane belongs to that small and misguided group of scoffers at education which is rapidly passing away.

PROSPERITY AND THE CROPS.

After all, this question of prosperity finally gets back to the crops. The bountiful harvest of last summer and fall has been given the credit for providing the foundations of the unusual run of business for the nine months past. Even months before the harvest time a fairly accurate forecast of what could be expected from the farms was available and railway improvements, building operations and other activities were pushed along with the assurance that the greatest factor of wealth production in America was fairly overdoing itself. When the grain had all been gathered, there was no disappointment, the brightest prediction had been fulfilled and the yield of wheat and corn was of record proportions. Prosperity was inevitable. There were the pessimists, of course, who made the most of the fact that some loss to the farmer was occasioned through inability to market his products promptly and through storage in ill-constructed warehouses, but the fact remains that crops which had never been surpassed were disposed of at prices as high as had ever existed in normal years. The impetus thus given to manufacturing held activities at full swing through the year.

Naturally there is wide interest in the story the farms will tell during 1907. Already the area under fall tillage is pretty accurately known; it exceeds the fall tillage record for 1906 by about 300,000 acres. In regard to spring tillage, estimates as yet are at wide variance. Some state that the increase over the corresponding tillage in 1906 will reach 500,000 acres; others hold that it may not be greater than 300,000 acres. Perhaps it will not record so heavy a gain as the minimum figures, but there is no reason for doubting that the acreage under cultivation for the 1907 harvest will be very much in excess of that for the previous year. Whether or not agricultural conditions will prove favorable between the present and the time the yield is gathered, is also a point of uncertainty, of course. So far as definite information is to be had, however, the prospect is that the farmer is to have at least as bountiful year as in the one just closed.

Until the certainty of the harvest is manifested, there may be some hesitancy in contracting far ahead for steel products. Money conditions will doubtless remain somewhat acute and unsettled until the full facts are known, and this fact, coupled with the well known shortage of labor, will tend to hold back some improvement and extension work on the part of the railroads. Steel interests will welcome this; orders for materials already financed and for the placing of which definite arrangements have been made will keep the iron and steel plants busy until long after the time of uncertainty over the crops is past. Then, if the yield is anything like that now indicated, the situation will take care of itself.

FUTURE SAFEGUARDS

Strengthened by American Radiator Co. During Past Year—Good Earning Record.

President Clarence M. Woolley, of the American Radiator Co., in his statement to the stockholders covering the fiscal year, ending Jan. 31, says that the business of the company has reached proportions which greatly exceed its total capital. This was due to the fact that the selling prices were not advanced as rapidly or to the same extent as were the prices of raw materials. Mr. Woolley points out that the company was aided in enlarging the volume while securing a satisfactory return on the total business transacted.

	1907.	1906.	Increase.
Net profits.....	$864,281	$833,917	$30,364
Div. pfd. stk. (4 per cent)	210,000	210,000	.....
Balance	$654,281	$623,917	$30,364
Div. com. stk. (4 per cent)	200,000	196,013	3,987
Surplus	$454,281	$427,904	$26,377

GENERAL BALANCE SHEET.

Assets—	1907.	1906.	Increase.
Real est., plant, etc.	$7,976,641	$7,600,853	$375,788
Additions during year	392,649	475,788	*83,138
Total	$8,369,290	$8,076,641	$292,649
Less dep'n	100,000	100,000	.....
Balance	$8,269,290	$7,976,641	$292,649
Cash	308,541	376,121	*67,580
Notes receivable	15,986	12,004	3,982
Accts. receivable	2,535,568	2,151,953	383,651
Raw mat., supplies, and finished products	1,370,332	1,626,370	*256,038
Total $12,499,717	$12,143,089	$356,628	
Liabilities—			
Pfd. stock	$3,000,000	$3,000,000	.....
Com. stock ...	5,000,000	4,922,300	$77,700
Accts. and bills payable	1,115,645	1,290,998	*175,354
P. & L. Surplus	3,384,072	2,929,791	454,281
Total $12,499,717	$12,143,089	$356,628	

*Decrease.

QUICK ASSETS AND LIABILITIES.

	1907.	1906.	Increase.
Total quick assets	$4,230,427	$4,166,448	$63,979
Less accts. and bills payable..	1,115,645	1,290,998	*175,353
Net quick assets	$3,114,782	$2,875,450	$239,332

*Decrease.

"The first year of our corporate existence the volume of business was less than one-half of the capitalization. It is, therefore, obvious that the larger measure of business can be transacted under conditions which accrue to the greater advantage of the public and of the company. The phenomenal business conditions which prevailed during the fiscal year created abnormal activity in the metal markets and rendered it difficult to obtain supplies."

During the year the company safeguarded its future by substantial reservations from its profits for an insurance fund to protect the company against a decline in the value of its finished products. In addition, the sum of $100,000 has been deducted from the earnings and used as a guaranty fund for bad accounts. The report states that the foreign plants are in a healthy condition of development. The plant erected in England last year is now in operation, the plant in Germany is being further extended to meet increased demands, and the plant in France has also been largely increased. The comparative income account of the company for the fiscal year ending Jan. 31, 1907, is shown in the accompanying table.

STEEL CAR PLANT

Of the American Car & Foundry Co. at St. Louis Nearly Completed.

St. Louis, March 8.—The American Car & Foundry Co. is now completing its all-steel car plant in St. Louis, and will put it in commission about April 1. The management intends to employ, regularly, about 2,500 men in this new plant. The daily output will be 60 all-steel freight cars. The buildings and grounds cover an area 2,000 feet long and 250 feet wide. The main building is constructed of steel, with walls of corrugated steel, and it is 1,175 feet long and 187 feet wide. The building is high and strong, and it is equipped with traveling cranes, operated by electricity. The yards are laid out for the expeditious handling of material and finished equipment, and they, too, are equipped with electric cranes. The buildings, grounds and machinery represent a total investment of about $2,000,000, or about $500,000 more than was contemplated in the original plans. Besides the main building, there are many small buildings, such as power houses and supply depots.

The company has just finished its new car wheel works at Madison, Ill., opposite St. Louis. The construction necessitated only the remodeling of an existing building, and the cost of the improvement is about $150,000. About 400 men will be employed in this plant, and the output will be 600 car wheels per day.

The American Car & Foundry Co. employs about 10,100 men in its plants at St. Louis, Madison and St. Charles. In the now all-steel car plant in South St. Louis, about 2,500 workmen will be engaged, and in the Madison car wheel works about 400. In the all-steel car works at Madison, 3,250 men are employed, in the wooden car works at St. Louis 2,500 men, and in the wooden car works at St. Charles 1,500 men.

The total daily output of the St. Louis, Madison and St. Charles car plants is 100 all-steel freight cars and 80 wooden cars. The St. Charles car works turn out 25 passenger coaches per month and 20 wooden freight cars per day. The St. Louis works turn out 60 wooden cars per day.

COMMITTEE PLEASED

With Reception at Duluth, but No Definite Announcement Made.

The committee of the United States Steel Corporation appointed, as stated in the last issue of THE IRON TRADE REVIEW, to consider the building of a steel plant at Duluth has, during the past week, sent its representatives to investigate the situation there. The committee making the trip consisted of W. B. Dickson, second vice president of the United States Steel Corporation; F. W. Robinson, first vice president of the Illinois Steel Co.; M. H. Neeland, S. A. Benner, John Reis and E. E. Slick. While the committee did not express itself definitely as to its opinion resulting from the investigation, it stated that it had come without prejudice and was greatly gratified at the splendid manner in which the committee had been given an opportunity to see the conditions at Duluth.

A trip was made over the works of the Great Northern Power Co., beginning at the dam at Thompson, 26 miles from Duluth and including the generating and terminal stations. While the location most probable of selection seems to be West Duluth, the committee included in its inquiry Proctor and Two Harbors. The visitors were entertained at a banquet by the Commercial Club of Duluth, at which time among others Mr. Dickson spoke, saying in part that the decision in the matter would be based primarily on the question of dividends; that the natural thing to do would be the building of a blast furnace plant of four stacks, with mills of proportionate capacity, and it was a quetsion whether such an installation would find a market adequate to take care of the output. There seems to be a well defined feeling at Duluth that the impression of the committee was favorable, although no direct statements to that effect were made.

Gary Bill Vetoed.—Governor Hanly of Indiana has vetoed the bill introduced in the legislature of that state for the purpose of giving the title of certain submerged land at the Indiana end of Lake Michigan to the owners of the land abutting the lake. The measure was introduced in the interests of the United States Steel Corporation and the town of Gary. The veto was based on two reasons—that the bill in its present form probably is not constitutional, and that it safeguards the rights of neither the state nor the corporation. The governor's veto suggests that the title should not be given until the land actually has been filled in.

LARGE INCREASE

In Production of Bessemer Ingots, Castings and Rails.

The American Iron and Steel Association has compiled complete statistics of the production of Bessemer steel ingots and castings in the United States in 1906; also of Bessemer steel rails rolled by the producers of Bessemer steel ingots, as follows:

Ingots and Castings.—The total production of Bessemer steel ingots and castings in 1906 was 12,275,253 gross tons, against 10,941,375 tons in 1905, an increase of 1,333,878 tons, or over 12.1 per cent. The production in 1906 was the largest in our history. The following table gives the production of Bessemer steel ingots and castings in the last six years. Of the production last year about 32,000 tons were steel castings, against 22,103 tons in 1905.

Years. Gross tons.	Ingots and castings.	Years. Gross tons.	Ingots and castings.
1901	8,713,302	1904	7,859,140
1902	9,138,363	1905	10,941,375
1903	8,592,829	1906	12,275,253

Below we give by states the production of Bessemer ingots and castings since 1903.

States—Ingots and castings.	1903. Gross tons.	1904. Gross tons.	1905. Gross tons.	1906. Gross tons.
Pennsylvania	3,909,436	3,464,650	4,491,445	4,826,725
Ohio	2,330,134	2,050,115	3,131,149	3,769,913
Illinois	1,366,569	1,257,190	1,651,250	1,685,056
Other States	986,690	1,087,185	1,667,531	1,993,559
Total	8,592,829	7,859,140	10,941,375	12,275,253

Rails.—The production of all kinds of Bessemer steel rails by the makers of Bessemer steel ingots in 1906 was 3,705,642 gross tons against 3,135,729 tons in 1905, an increase of 569,913 tons. The maximum production of Bessemer steel rails by the makers of Bessemer ingots was reached in 1906.

The following table gives the production by states of Bessemer steel rails by the producers of Bessemer steel ingots in the last four years. Included in the figures for 1906 are 144,738 tons of rerolled or renewed rails rolled by companies which manufacture Bessemer ingots.

States—Rails.	1903. Gross tons.	1904. Gross tons.	1905. Gross tons.	1906. Gross tons.
Pennsylvania	1,185,191	801,657	1,095,154	1,298,409
Other States	1,688,037	1,283,031	2,040,575	1,407,233
Total	2,873,228	2,084,688	3,135,729	3,705,642

In the following table we separate the production of rails weighing 45 pounds and less than 85 pounds to the yard from those weighing less than 45 pounds and over 85 pounds. Bessemer rails rolled by companies which do not make Bessemer ingots are not included.

States—Rails. Gross tons.	Under 45 pounds.	45 pounds and less than 85.	85 pounds and over.	Total. Gross tons.
Pennsylvania	130,361	548,132	619,916	1,298,409
Other States	92,997	1,060,661	1,253,575	2,407,233
Total	223,358	1,608,793	1,873,491	3,705,642

The total production of rails in 1906 will include rails made from open-hearth steel, rails rolled from purchased blooms, crop ends, and "seconds" rails rerolled or renewed by non-producers of steel ingots, and iron rails. The total from all these sources in 1905 amounted to 240,200 tons, of which quantity 183,264 tons were open-hearth steel rails, 56,618 tons were Bessemer rails rolled by non-producers of Bessemer ingots, and 318 tons were iron rails. In 1906 the total from these sources will amount to about 300,000 tons, making the total rail production for that year about 4,000,000 tons.

In 1906 this country exported 328,036 tons of steel rails. No iron rails were exported. We imported 4,943 tons of iron and steel rails.

Buffalo Employers Elect.—The annual meeting of the Buffalo branch of the National Metal Trades Association was held at the quarters of the association at Buffalo, March 7, and the following officers were elected; Henry May, Geo. N. Pierce Co., president; W. H. Crosby, B. Crosby Co., vice president; H. R. Ford, McCarthy Bros. & Ford, treasurer; John E. Corss, secretary; executive committee, Henry May, William H. Crosby, H. R. Ford, Henry W. Wendt, R. W. Gardner, R. C. Adams. Plans are under way for a dinner.

A Short Stop.—A temporary coal famine which last week forced the closing down of a part of the Midvale Steel Works for a few days gave rise to reports that the company had been merged with various other large steel works and that the suspension followed the completion of the merger. This rumor is declared by President Harrah to be entirely without foundation. It is stated that the company has on hand orders for 5,800 tons of armor plate, sufficient to keep that portion of the works in operation for a year.

IN EXCELLENT CONDITION.

General Prosperity of Philadelphia Foundries.—A. F. A. Headquarters.

An informal symposium on foundry trade conditions was an interesting feature of the monthly meeting of the Philadelphia Foundrymen's Association, which was held at the Manufacturers' Club on March 6. In view of the numerous reports that have appeared about the crest of the wave of prosperity having passed and the long feared decline having begun, Secretary Howard Evans asked the members what their experiences had been. The answers were unanimously satisfactory and showed conditions to be even better than have been generally stated.

Brief remarks were made by representatives of the Abram Cox Howe Co., Schaum & Uhlinger, the Bethlehem Steel Co., the United States Cast Iron Pipe & Foundry Co., the Camden Iron Works, the Enterprise Mfg. Co., William Sellers & Co., the Fairbanks Scale Co., the Dixon Crucible Co., and others, all of which showed that the foundry trade is in most excellent shape, with orders on hand that insure activity for many months to come. Concerns engaged exclusively in the manufacture of specialties reported that they had all the business they could handle, and others engaged in a general foundry trade reported in many cases that they could not take any more orders.

The surprising statement was made by one manufacturer that his company was already negotiating for steel for the summer of 1908, a special grade being used. Vice president A. E. Outerbridge, who occupied the chair in the absence of President Devlin, speaking for Wm. Sellers & Co., said that it had been compelled to send work out and that it was far behind in its orders.

H. L. Haldeman, of the Pulaski Iron Co., and George C. Davies, of Pilling & Crane, speaking for the pig iron trade, said that they could see no signs of a let up in trade, that reports showed that foundries were full of work and that larger sales of iron had been made for the third and fourth quarters. It was generally agreed that the prospects all around were most flattering.

The entertainment committee reported that the Bellevue-Stratford Hotel had been selected as headquarters for the coming convention of the American Foundrymen's Association. The technical paper of the evening was presented by W. A. Pollock Davis on "Introduction of Nickel and Molybdenum in Foundry Practice." A lunch followed the meeting.

BLAST FURNACE STATISTICS

Show Large February Production, but Tendency Toward Decreased Capacity.

Reports from 374 blast furnaces, of which 320 were active some time during the month of February, show a production of 2,047,036 tons. The number of furnaces given, 374, does not include those furnaces which have been a long time out of blast and so may not be considered longer as temporarily idle. In view of the short month the monthly production indicates a greater daily output than in January, when 2,174,801 tons of iron were made, the figures showing 73,108 for February against 70,155 in January. Production in several instances was hindered by lack of fuel, causing the banking of furnaces, particularly in southern Ohio and in the south. Toward the end of the month as shown by the number of furnaces in blast on the last day the tendency was in the direction of decreased capacity in blast.

In explanation of the column headed "Number of Days Out of Blast per Furnace," it may be well to say that the aggregate number of days for which the several idle furnaces were out of blast has been averaged in each state to show the relative activity of all furnaces by dividing this total number of days idle in each state by the number of furnaces, thus denoting the possible increase in the total production by the "per furnace" inactivity. The figure at the bottom of this column is the average figure, on the same basis, for production in all states. A number of furnaces have shown the effects of the hard campaign through which they have gone, and are out for complete relining or temporary repairs, and it may be expected that in the present month an increasing number will be forced to do likewise. This blowing out of so many furnaces using coke from the Connellsville region has left a large quantity of that coke on the market, inducing a greatly weakened condition.

As indicated, the production of the merchant furnaces was 564,008 tons, as compared with 1,483,028 tons by steel companies. Included under steel companies are those producers, which besides operating blast furnaces, control steel mills or mills where it is possible to use their own product. The object of this classification is to indicate a partial distinction between that iron which goes only through the market, and that which may be sold otherwise.

FURNACE REPORT.

State.	No. of stacks.	No. in blast sometime during month. Feb.	Jan.	No. in blast on last day of month. Feb.	Jan.	No. days out of blast per furnace.	Actual make. Steel Co.'s.	Merchant Co.'s.	Total. Feb.	Jan.
Pennsylvania	147	131	129	129	127	3.13	725,105	171,527	896,632	911,273
Ferro							8,616		8,616	5,137
Ohio	60	58	57	57	57	1.25	318,934	142,465	461,399	489,303
Ferro								1,311	1,311	1,425
Alabama	42	30	32	29	31	8.36	89,929	39,961	129,890	145,794
Virginia	21	16	16	15	15	5.67	16,593	23,319	39,912	39,100
New York	24	19	19	17	18	7.37	62,588	63,328	125,916	140,249
New Jersey	10	9	9	9	9	2.8		29,031	29,031	32,356
Spiegel								698	698	
Tennessee	18	13	13	11	12	10.1				
West Virginia	4	4	2	4	2	8.25	25,777	34,247	60,024	97,447
Kentucky	6	2	2	2	2	14				
Ferro										1,950
Maryland	4	4	4	4	4					
Spiegel										
Illinois	23	21	21	21	21	2.43				
Spiegel							6,244		6,244	
Wisconsin	5	5	5	4	5	1.4	229,045	44,427	273,472	296,235
Colorado	5	5	5	4	5	4.2				
Spiegel							197		197	442
Georgia	1	0	0	0	0	28				
North Carolina	1	0	0	0	0	28				
Minnesota	1	1	1	0	1	1		13,694	13,694	14,090
Michigan	1	1	1	1	1	0				
Missouri	1	1	1	1	1	0				
Totals	374	320	317	308	311	*7.78 Average.	1,483,028	564,008	2,047,036	2,174,801

SONS OF VULCAN REORGANIZE.

At a meeting of the puddlers and muck iron rollers, affiliated with the Amalgamated Association of Iron, Steel and Tin Plate workers, held at Pittsburg Sunday, March 10, the Sons of Vulcan was reorganized and the withdrawal from the parent association was officially effected. John Weigand was elected national president, and Matthew McClure, national secretary; John O'Rourke, John L. Williams and Phillip Gavick were chosen trustees. A charter has been applied for and the next meeting will be held March 24.

PERSONALS.

George Beals, manager of the Buffalo office of the Jones & Laughlin Steel Co., Pittsburg, has resigned and will be succeeded on April 1, by C. H. Bradley, assistant manager of the New York office of this company.

George K. Preston, secretary to A. C. Dinkey, president of the Carnegie Steel Co., Pittsburg, has been appointed assistant to the first vice president of the company to succeed Homer J. Lindsay, who died recently.

G. H. Schuler, who resigned as treasurer of the Southern Steel Co. and retires from that position on April 1, will be succeeded by A. R. Forsythe, who is one of the assistant cashiers at the First National bank of Birmingham. Mr. Schuler will retain his position on the directory of the Southern Steel Co. and with his brother and friends, controls the company. Mr. Schuler will take a two months' yachting trip on southern waters and on May 31 will sail with his family for a trip of several months in foreign countries.

W. S. Morehouse recently resigned his position with the A. S. Cameron Steam Pump Works, East Twenty-third street, New York, to accept the position of works manager with the Green Fuel Economizer Co., Matteawan, N. Y., manufacturer of fuel economizers, air heaters, steel plate fans, blowers and exhausters. He is a graduate of the Worcester Polytechnic Institute, a member of the American Society of Mechanical Engineers and of the American Foundrymen's Association.

THE ECONOMICAL PRODUCTION OF PIG IRON.[1]

A STUDY OF CONDITIONS EXISTING IN THE BLAST FURNACE.

A Theoretical and Mathematical Discussion of the Factors Necessary for Maximum Efficiency.

By Horace Allen.

An extended study of the smelting of iron ores in the blast furnace, from a practical and theoretical point of view, following the practice from its infancy, has induced the author to submit his conclusions to the consideration of those interested in the economical production of pig iron by means of the blast furnace.

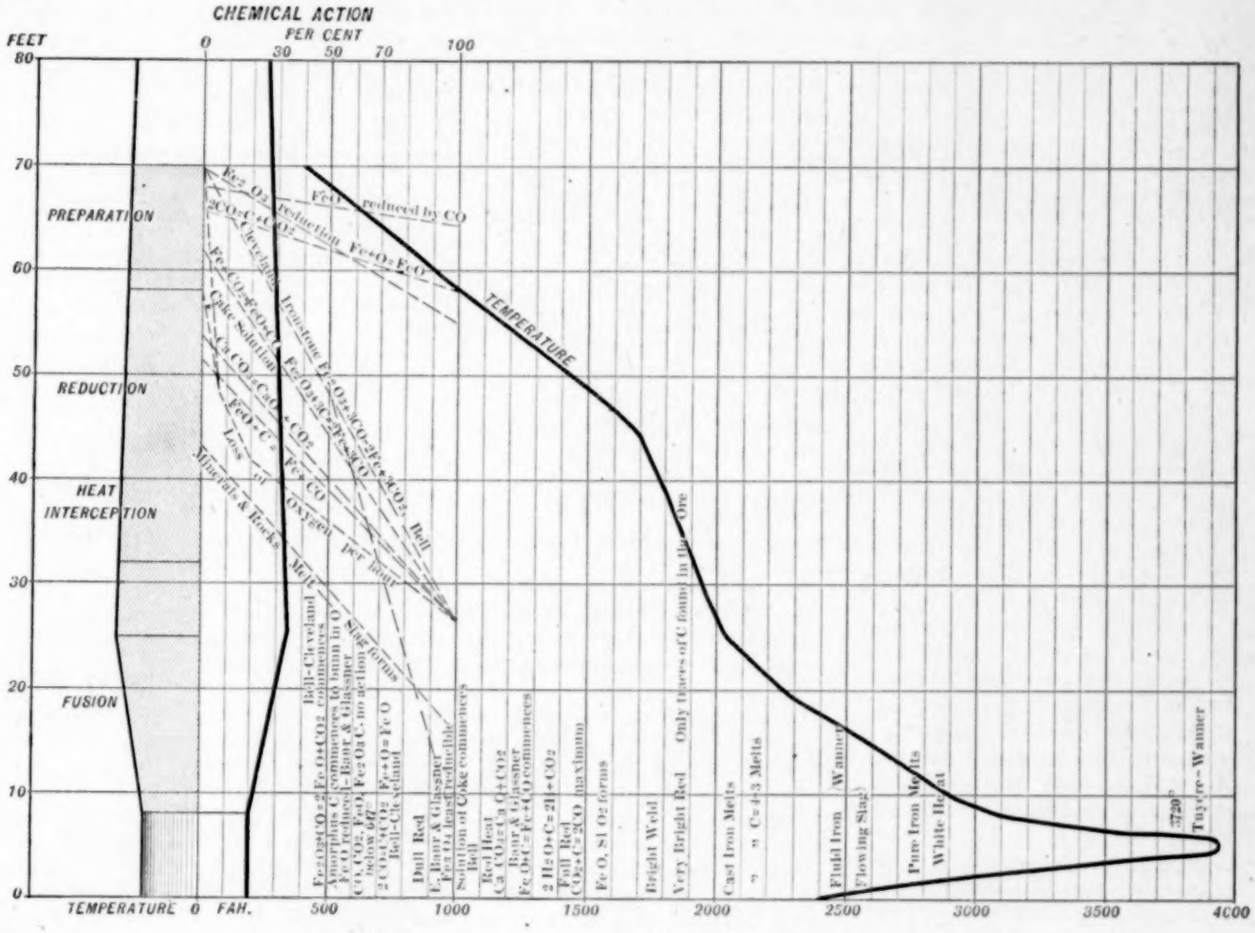
The production of pig iron taken from a general and inclusive point of view is somewhat complicated, because the ores smelted are of considerable variety, the class of fuel varies from charcoal, raw coal, coal and coke to coke only; prepared from various classes of coal; and the fluxing material required to be provided differs with the class of ore to be smelted and the quality of the product desired.

Again, the air required for the combustion of the fuel employed for the reduction of the ores is delivered in the furnace, either at atmospheric temperature, or heated to temperatures ranging from 800 or 900 degrees Fahr., when pipe stoves are employed, to from 1,000 to 1,400 degrees Fahr., when fire brick stoves are adopted.

Though pig iron differs very greatly from the early practice of malleable iron production, by the primitive processes, direct from the ores, these processes have indicated the shape that furnaces should be built to produce the maximum output.

The "Catalan" and "Italian" processes have, during the many years of application, proved that in relation to the blast furnace "bosh," an angle of structure somewhere about 70 degrees from the horizontal was most effective and this angle, determined by long experience agrees with theoretical considerations of the present day. In these processes the side of the furnace opposite the tuyere was not kept vertical but inclined at an angle and the best angle for this wall was found to be somewhere in the neighborhood of 70 degrees.

In smelting iron from its ores, the usual practice is to mix the ore with the required amount of fuel and flux, and as the combustion of the fuel pro-



Temperature and Chemical Changes in the Zones of a Blast Furnace.

[1]First of a series of articles on the blast furnace. These will appear in the second issue of each month.

ducing the reducing gases chiefly takes place in the proximity of the air pipe, or tuyere, the contraction of bulk, owing to the gasification of the fuel, coincides with the reduction of area caused by the sides of the furnace having an angle of about 70 degrees.

Taking, for instance, a furnace 80 feet high, with a bosh 19 feet diameter working on a charge of:

Ore 36.2 cwt. at 157 pounds per cubic foot.

Limestone 9.0 cwt. at 85 pounds per cubic foot.

Coke 22.7 cwt. at 30 pounds per cubic foot.

When these materials are mixed there would be a contraction of volume of about 4.5 per cent.

The volume occupied by the materials to produce a ton of pig iron would be:

Ore	25.82	cubic feet
Limestone	11.86	" "
Coke	84.75	" "
	122.43	" "
Deduct 4.5 %	5.51	
Volume per ton of pig	116.92	" "

When these materials pass the tuyeres the volume would become:

1 ton iron @ 432.21 = 5.18 cubic feet
13¼ cwt. slag @ 182.81 = 8.12 cu. ft.

At that point of the hearth where the blast comes in contact with the coke this substance passes into the gaseous form, but as this occurs in the immediate vicinity of highly heated carbons the carbonic acid gas formed becomes converted into carbonic oxide, an equal weight of carbon being gasified as was burnt to carbonic acid. Also, at the point of formation of CO_2, the temperature is so high as to render liquid the metal and slag; this being the most intensely heated portion of the furnace.

The cubic space occupied by the materials of the burden at that part of the furnace where the CO_2 becomes CO may be taken to be, per ton of pig iron:

Ore 25.82—5.18 =	20.64	cubic feet
Limestone	11.86	" "
	32.50	" "

The ratio between the 116.92 cubic feet occupied by the raw materials, and the figure above, 32.5 cubic feet, will give the ratio between the area at the top of the bosh and the top of the hearth.

For the furnace assumed, the area of the bosh = 283.53 square feet, so the area at the hearth would be 116.92: 32.5:: 283.53: 79, which would be equivalent to a diameter of 10 feet 1 inch, a figure nearly agreeing with the actual hearth diameter of 11 feet 0 inches.

The area of the bosh should therefore be about 3.6 times the area of the hearth. A similar comparison taking a furnace making "spiegeleisen" was found to give a ratio of 3.21 to 1.

The more general application of the pyrometer to metallurgical processes enables us to form a much better idea as to the effect of temperature upon the chemical changes and the rate at which chemical reaction proceeds under different degrees of heat, than could otherwise be the case. For several years, the writer has collated the principal data that have come under his notice in regard to the temperatures occurring at different parts of the iron smelting blast furnace, as well as the temperatures at which the associated chemical action commences and proceeds to maximum rate. Thanks to recent workers in the direction of pyrometrical determinations, and other sources, it has been possible to prepare a diagrammatic table of the principal reactions occurring in the process of smelting iron from its ores. The first diagram prepared on this subject, appeared in the *Engineer*, London, while a second one, corrected by more recent data, was published in *The Iron and Coal Trades Review*, London, in July, 1905, but with only a brief reference. It is intended now to consider it more fully than has been done previously, and as it always constitutes a useful reference, it is reproduced in an amended form. Commencing in somewhat inverted order, we see that the temperature of fluid iron and flowing slag is given by Wanner as about 2,500 degrees Fahr., and it is probable that this temperature very nearly approximates to that of the iron and slag as it issues from any size of blast furnace and for most classes of ore smelted, as well as for the different brands of iron produced.

Taking the specific heat of iron at 0.20, we have as the total heat of iron per pound:

Deg. Fahr.	Sp. ht.	latent ht.	B. T. U.
1 x 2,500	x 0.20	+ 125	= 625.

Where the weight of slag produced is half that of the iron, and taking the total heat per pound of slag at 990, we have:

990 ÷ 2 = 495 or 1,120 B. T. U. as the total heat carried out of the furnace by iron and slag for one pound of iron produced. The gases evolved in the process of smelting leave the furnace in a highly heated state, ranging from, say, 400 degrees Fahr. to 1,000 degrees Fahr., according to the height of the stack; as this height is continually varying, it will be convenient to take the mean of the above temperatures as representing average conditions, or 700 degrees Fahr. As for each unit of coke consumed, there are produced about 5.75 units, by weight, of gases, the weight of gases per pound of iron produced would be:

WEIGHT OF GASES PER POUND.

	At 1,750 pounds of coke per ton of iron.	At 1,800 pounds of coke per ton of iron.
Gases per pound of Iron	4.87 pounds 61.18 cu. ft.	5.157 pounds 64.18 cu. ft.
Heat carried out by gases per lb. of iron. sp. ht. deg. F.		
4.87 x 0.27 x 700	920 B. T. U.	
5.157 x 0.27 x 700	974 B. T. U.	
Thermal value of gases at 100 B. T. U. per cu. ft.	6,118 B. T. U.	6,478 B. T. U.
Gross value of coke delivered to the furnace per pound of iron produced, at 13,500 B. T. U. per lb.	11,475 B. T. U.	12,150 B. T. U.

PER POUND OF IRON PRODUCED.

	1,700 lb. coke per ton of iron			1,800 lb. coke per ton of iron.			
	B. T. U.	Per Cent.		B. T. U.	Per Cent.		
Heat carried out by gases	920	8.0		974	8.0		
Heat power of gases	4,345	37.8		4601	37.9		
Heat utilized in smelting	1773	15.4	44.4	1877	15.4	44.9	
and							
Heat loss by radiation	3317	29.0		3578	29.5		
Heat carried out by the iron	625	5.5		625	5.5		
Heat carried out by the slag	495	4.3		495	4.1		
Gross heat delivered to furnace	11475	100		12150	100		

In regard to the heat carried out of the furnace *as sensible heat* in the gases, the total quantity of eight per cent of the gross heat value of the coke charged is not all available for recovery as a by-product for the portion of the gases which are employed in stoves for heating the blast is not cooled down to any great extent, by radiation in the flues, but the physical temperature is turned to account in developing heat in the stoves, and greatly assists in promoting the inflammation of the gases, so that of the eight per cent only 5.7 per cent remains to be considered. Where the gases are employed for raising steam in boilers, heating drying stoves or other such purposes the sensible heat is fully utilized, but where the gases are used for driving gas engines, the preliminary cooling generally renders a loss of this sensible heat unavoidable, in proportion to the quantity so utilized.

To deal now with the heat capable of being developed by combustion of the evolved gases, we see that the

gross amount of heat carried out of the furnace amounts to over 50 per cent of the gross heat of the coke, but something over 15 per cent of this has to be applied to raising the temperature of the air blast to about 1,200—1,400 degrees Fahr. in hot blast stoves, unless producer gas made from common slack coal, is used for the stoves, and the furnace gases put to more profitable account. When the gases are applied to driving gas engines instead of being burned under boilers, etc., for each 2 to 2½ pounds of iron produced per hour, there would be one horsepower available for providing the power requirements of the furnace and profit earning. The thermal requirements of the process of smelting only accounts for a gross proportion of the heat of the coke of 54 per cent.

From an examination of the chemical reactions occurring in the blast furnace, it will be noted that there is considerable complication and interchange, which is also accompanied by changes in heat development or absorption. While we have reduction and oxidation of the iron alternating and carbon deposition and oxidation also occurring during the descent of the materials through the furnace, it would appear that in whatever proportion, in regard to size of pieces, the ore is introduced into the furnace, satisfactory reduction can take place either by carbon in the gaseous state as carbon monoxide or by solid carbon precipitated from the gases; the fuel and ore being therefore capable of entering into chemical reactions regardless of the sizes in which they are charged into the furnace.

In the case of the slag forming materials carried with the ore and fuel, and the flux added, the reaction of the different constituents to form slag differs considerably from that of carbon and oxide of iron.

In the cases where the flux consists of limestone, $CaCO_3$, it is usually charged in lumps of considerable size and weight, and although mixed up with the other ingredients of the charge in the required proportion, no change occurs in it from the ore, fuel, or gases, until its temperature becomes raised to 1,200 degrees Fahr., when it commences to give off its carbonic acid, CO_2; this, however, does not, to any extent, change its bulk, as the lime remaining, CaO, still occupies about the same space. The constituents, which are to be formed into slag, therefore, not being affected by the gases, can only enter into chemical combination when brought into sufficiently intimate contact.

The principal constituents of slag, silica, alumina and lime are almost infusible, but a combination of them can readily be melted and run out of the furnace in a liquid state, so that as the flux and earthy matter come into contact at temperatures above 1,600 degrees Fahr., chemical combination takes place gradually until a temperature of about 2,600 degrees Fahr. is reached when the compound flows in a liquid state. The question arises as to whether it would not be better to take more precautions to bring the materials for slag formation into more intimate contact, and whether the cost of the crushing of the limestone would be repaid.

There is no doubt of the economy resulting from the employment, where possible, of classes of ore that are so constituted in regard to earthy matter as to become self-fluxing when mixed in proper proportions, but even then, the same question of intimacy of contact applies. The combination of silica with oxide of iron taking place as it does at temperatures above 1,600 degrees Fahr. will probably be the preliminary stage of slag formation in all blast furnaces.

We are indebted to Messrs. H. E. H. Carpenter and B. F. E. Keeling for the following determinations of the melting point, or point of commencement of solidification of iron containing varying proportions of carbon:

Pct'age of carbon	Commencement to solidify. Degrees Fahr.
4.3	2,080
4.0	2,144
3.0	2,330
2.0	2,395
1.0	2,632
0.0 pure iron.	2,740

Philippine Imports.—The exports from Glasgow to the Philippine Islands for the quarter ending Dec. 31, 1906, shows an increase of $189,421 over the corresponding period of 1905. Consul R. W. Austin reports that these exports included iron and steel of the valuation of $173,259 for the quarter ending Dec. 31, 1906, as against $3,810 for the quarter ending Dec. 31, 1905; $1,843 in pig iron in 1906, as against $2,279 in 1905, and $4,916 in machinery in 1906, compared with $17,778 in 1905.

The Westinghouse Electric & Mfg. Co. has gained a victory in the United States Court of Appeals in Chicago based upon an invention of Nikola Tesla, covering an original idea of operating electric meters, for which the United Sattes patent office granted him two patents.

GAS ENGINES

Discussed by the South Staffordshire Iron and Steel Institute.

The fourth meeting of the South Staffordshire Iron and Fuel Institute was held at the Institute, Dudley, England, Feb. 16, under the presidency of William Somers. There were also present W. Jones, R. Buchanan, L. D. Thomas, C. Edwards, R. G. Mercer, H. Allen, R. Edwards, W. J. Foster, S. Moore, W. Micklewright, J. Piper, J. P. Tilley, F. Lewis, E. A. Dowson, W. Lindon, W. Perry, W. Fennell, W. H. Carder, secretary, and others.

A paper was read on "Internal Combustion Engines" by Prof. F. W. Burstall, of which the following is an abstract:

The Gas Engine.

Up to about ten years ago gas or oil engines, while in very common use, were almost entirely confined to comparatively small sizes, that is, up to some 50 horsepower. The reason for this was the fact that when working on illuminating gas the cost was too high to prevent the large engines from seriously competing with steam. There were several comparatively big plants working on Dowson gas, but no engines were then made of any size larger than some 200 to 250 horsepower.

With all the advantages of economy that the gas engine possessed compared with steam, there arose a considerable demand for an engine of a larger size, that is, powers of 100 horsepower upwards, and to be worked with some of the cheap gases of the lower calorific value, made either from anthracite or bituminous coal. When the diameter of the piston was increased to some 19 inches, and all the values increased in proportion, difficulties came into existence, which were not serious in smaller engines. It was found that the large pistons became very hot when continually working at full load, leading in many cases to pre-ignitions—which not only seriously reduces the power of the engine, but is also liable to cause very heavy stresses on the engine itself, leading to serious breakages. The inlet and exhaust valves also suffer from the same difficulty, and become over-heated, and it was found that the hit and miss principle did not give sufficiently close governing for dynamo driving, for which the greater number of these larger engines were called upon to perform. It was from these troubles that the modern large internal combustion engine has been developed.

Some five or six years ago the manufacture of large gas engines was seriously taken up on the continent by quite a number of firms. To mention only a few of the best known names, there

would be the Cockerill engine as developed by the famous iron works at Seraing, and the Nurnburg engine. Economical conditions on the continent led to a very considerable demand for engines using the waste gases from blast furnaces, and supplying either air for blowing or electricity. For power purposes the large number of furnaces put down in Germany give the engine makers of that country a chance to develop a large engine, and to this fact may be attributed the much larger developments of large combustion engines on the continent than in this country, where the great majority of blast furnaces installed had their steam blowing plant. The demand in this country is mainly for engines from 200 to 700 horsepower to work on producer gas. As a rule the governing has to be distinctly good, and the engine is expected to make long non-stop runs, and to give comparatively little trouble in the way of renewals and repairs. Engines larger than this are generally installed to work on blast furnace gas, in which the problem is much easier than producer gas, owing to the fact that blast furnace gas is mainly carbon mon-oxide, which is not nearly so liable to pre-ignitions as the hydrogen and the hydro-carbons found in producer gas.

Scavenging Methods.

The most important large engines of purely British origin are those developed by the Premier Gas Engine Co., of Nottingham, and Crossley Bros., of Manchester. The Premier engine makes a special feature of the use of a scavenger charge, that is, a current of cold air is passed through the motor cylinder during exhaust, performing the double action of cooling the cylinder and the products. There is no doubt whatever that this is a step in the right direction, as regards both economy in fuel, and also in helping the engine to run continuously at full power, but it has, however, to some extent, complicated the engine, and it increases the first cost. Up to some 250 horsepower, the Premier engine is single cylinder with the inlet valve the top and the exhaust valve the bottom of the breech end; the speed regulation being by means of governing the gas from full load to half load, and below that by cutting out the gas charges altogether. The scavenger air is furnished by means of a differential piston, that is, the motor piston is connected with a larger piston to which is attached the bearings for carrying the gudgeon pin and connecting rod. The air passes through a trunk to an inlet valve, and thence straight across to the exhaust. Such troubles as were met with owing to heating have now been overcome by the introduction of water-cooled pistons and water-cooled inlet and exhaust valves, which are absolutely necessary when the cylinders are from 24 to 28 inches in diameter. In these engines the piston speed is about 700 feet per minute, and the speed of rotation about 150 revolutions per minute. Higher speeds than this are not desirable, owing very largely to the inertia effect, which, with these heavy engines, will frequently amount to as much as 60 to 70 pounds per square inch of piston area. I am of the opinion that speaking generally, large engines would work much better and smoother were the speed reduced by 10 per cent. In the larger Premier engines the tandem principle has been adopted. This arrangement causes an explosion every revolution, and does not require heavier crank shafts and connecting rods, than a single cylinder engine of half the power. The valve motion in the 500 horsepower and larger sizes is quite a departure from current English practice. The valves in place of being vertical are horizontal, the inlet valve being above the piston rod, and the exhaust valve below, so that the breech end of the cylinder is exactly the same form as a steam engine, and the clearance surfaces have the least possible area. The valves are both opened and closed by cams in place of being closed by springs alone, as is the case in ordinary practice. My own personal experience of these engines is highly favorable to this type of valve, more particularly in the compression, by raising it above the customary 120 pounds per square inch, in order to obtain additional economy.

Ignition Devices.

In all large engines the hot tube ignition has been altogether abandoned in favor of the low tension magneto. In general, each cylinder has two plugs, so that if the spark fails in one, it will pass at the other, and so ignite the gas. The magneto has some very serious drawbacks; the principal one being the difficulty of obtaining a spark should the points either become dirty or coated with water. Many forms of high tension ignition have been employed. Where the sparking distance in the cylinder is kept constant, and a current having a very high voltage generated in an induction coil is made to jump the gap at the correct time. This form is very widely used on petrol engines for motor work, and is very satisfactory, but it must be borne in mind that the conditions of say a four-cylinder petrol engine, running at 1,500 revolutions per minute, and supplied with such a very inflammable material as air with petrol vapor, is a much simpler problem as regards ignition than a large slow-speed engine, in which a missed ignition is a serious matter, whereas, with a quicker running motor, it is a matter of very small importance. The insulation difficulty, and the question of dirt has been practically solved by the Lodge ignition. In this form, the secondary winding of the induction coil is not carried to the sparking plug, but is connected to the outer covering of a Leyden jar, the inner covering being connected to the sparking plug. The primary current from a set of accumulators is arranged to pass at the correct time by means of a commutator on the lay shaft of the engine. This excites the secondary coil, which charges up the coating of the Leyden jar. When the primary current ceases to pass, owing to the rotation of the shaft, the secondary also dies away, and in cutting off the Leyden jar makes a disruptive discharge across the sparking point. The curious property of this spark is its indifference to water, dirt, oil of any kind, so that it becomes a matter of no importance as to the condition of the plug in sparking. I am of opinion that this type of ignition has many advantages over the low tension magneto, as regards the possibility of adjustment, certainty of ignition, and lack of trouble owing to dirty or bad insulation.

Cylinder Arrangements.

Messrs. Crossley Bros. have until quite recently built all their very large engines on the vis-a-vis principle, the cylinders facing each other, and two connecting rods driving a common crank pin. This arrangement, which originated with the Deutz firm at Cologne, has many drawbacks when applied to sizes larger than from 200 to 300 horsepower, the pressure in the cylinder which runs under being in the wrong direction, and some trouble results with regard to inertia difficulties. Quite a number of these engines are at work and doing satisfactorily. The special feature of the Crossley engine beyond those common to all large engines is the use of a balanced exhaust valve, so that the work required to open this valve is reduced, an important consideration when it is borne in mind that these large valves may have to open against a pressure of some 40 to 50 lbs. per square inch. The governing is by throttling the gas, and cutting out below half the load. Messrs. Crossley have recently turned their attention to the construction of the tandem type, but until we have more experience it will not be safe to say much about this type of engine. Among other large British engines the most common is the three or four cylinders, quick revolution engine, specially adapted for dynamo driving. This engine originated with the Westinghouse Co., but has since been developed to a considerable extent in this country. The speed is from 200 to 300 revolutions per minute. The lubrication is splash, there being an enclosed crank chamber. The governing is by means of a throttle valve reducing both air and gas at the same time, an arrangement which is particularly suitable for

electrical purposes. For some reason this type of engine is not very satisfactory in large sizes, indeed the vertical engine has not been a success with gas. The principal cause for this lack of good working is, in the writer's opinion, due to the fact that the engine has not been made sufficiently stiff. To be successful with the vertical gas engine, it will be necessary, to some extent, to return to the steam hammer type of guide, where actions similar to the gas engine are brought into play. The vertical engine has many advantages, and it no doubt will be developed as the need arises.

To mention only a few of the names, we may take the Nurnberg engine, the Cockerill engine, and Erhart, and others. In almost every case these engines are double-acting, with two or more cylinders driving one crank. Great care is taken to support all moving parts by means of cross-heads and bearings, so as to relieve the cylinders from the weight of the heavy pistons. The valve motion is by means of the inlet valve at the top, and the exhaust valve at the bottom; the opening of the valves being either by means of eccentrics, or by curved roller paths in which the leverage is variable. Double-acting engines in this country have not found, hitherto, great favor. Probably the reason for their success in Germany is due to the fact that blast furnace gas is very largely used, and next that the engines are so designed as to operate with fairly low mean pressure, some 60 to 85 pounds per square inch as against the English practice of some 80 to 110 pounds per square inch. Thus the charges are much weaker, and necessarily the heat developed in the cylinder is less, so that the difficulties due to expansion are not so serious. In a single-acting engine it is always possible to anchor one end of the liner, and allow the other end to move, whereas with a double action, there being valves at each end, the amount of motion allowed cannot be very great. Therefore expansion sets up considerable stresses in the line and outer frame. To avoid this difficulty the German engines are cast in one piece, the cylinder, the outside of the water jacket, and the valve chambers, so as to distribute as much as possible the stresses due to expansion, the cylinder covers being arranged to link on to the cylinder itself. These double-acting engines have been made up to as large as 2,000 horsepower, and there are probably working today some 30,000 horsepower of these engines.

There is also a certain amount of doubt as to how far these large double-acting engines will run when developing their power continuously; that is to say, night and day running without any stops. I rather incline to the opinion that British engineers will prefer to have the multi-cylinder engine—two, four, or six cylinders, either working on separate cranks, or arranged tandem, and they will prefer cylinders of moderate dimensions, that is, up to 32 inches diameter. Such engines as these we know can be run for very long periods, developing their full power, and I consider that they will not be more expensive than an engine of the same power and double-acting. As to the cost of operating it may be taken that the labor costs are about the same for gas as for steam. The oil can be brought down to the same amount, although in general a great deal more oil is used than is either necessary or advisable.

The entire saving is therefore over the fuel, and ruling out for the moment blast furnace gas, as this in general is a by-product, we shall find that a first-class gas engine will take about 60 feet of producer gas per brake-horsepower hour. In my own tests I have produced this quantity of gas from one pound of common slack costing, delivered, 8s per ton. That is, the fuel cost per horsepower hour is 0.04d. At the same station a very fine triple expansion steam engine, working with 200 pounds initial pressure and condensing, uses 15 pounds of steam per brake-horsepower hour. Direct comparison cannot be made with the same quality of coal, because common slack is unsuitable for firing in the boilers supplying this steam. Taking coal at 10s a pound and 2 pounds of coal per brake-horsepower hour, we get the cost of the steam at 0.107d. This does not take into account any steam pipe losses. Still further I have had an opportunity of comparing the coal costs for two very nearly similar steam and gas plants, each being about 400 horsepower and working for the same length of time. The result is that the coal used by the gas engine is just about one-third of that used by the steam plant, and I believe that in nearly all cases this economy can be reached. I have purposely excluded some of the very high figures on gas engines, which I have myself obtained, and only taken into account those which can be got in ordinary commercial practice. The question of reliability from breakdown is, I am well aware, often brought against the large gas engine, and I regret to say that too often it is true; but it is only to be expected when one considers the large number of types that have been put into operation, and also the lack of knowledge among drivers and operators connected with large gas engines. Given proper care and attention the large gas engine is very little less reliable than the steam plant, and I feel convinced that before many years we shall find the gas engine replacing steam up to quite large powers.

Discussion.

Mr. Hall, Birmingham, said he thought the principal reason that vertical engines had failed was the difficulty of lubricating them. The oils got into the crank-pit, and he thought a serious difficulty was the inadequate strength of the crank shaft. With regard to gas engines superseding steam engines of a similar size, that was not a question of the future, but of the past. They were much more economical, and required less attention, but their troubles began when they got up to 100 and 150 horsepower. The amount of repairs and attention required for the larger engine was enormous compared with the steam engine. The gas engine must be stopped for repairs occasionally, and in that case, they would require a spare plant.

Mr. Allen said that he had noticed in examining the recent list of patents out of thirty-eight inventions nine referred to ignition, but that was always electrical ignition.

Mr. Walter Jones suggested that gas engines should be standardized in the same way that steam engines were. Mr. Mercer strongly argued that the Westinghouse engine was the best engine, and mentioned a one hundred and fifty-horsepower engine in the north of England, which ran eight hours per day, and only consumed 2 gallons of oil per week. All gas engines were more or less unreliable, but the great thing was to have the plant accessible and the vertical engine was not so accessible as the horizontal.

Mr. Fennell said he was an electrical engineer, and he was looking for a gas engine for a municipal plant, but he had failed to find one, and every engineer he went to said his own engine was perfect and the rest were worthless. He was satisfied that the promises made of cheap production in connection with suction gas engines were fallacious. He was very much in the dark as to the capacity of engines.

Mr. Dowson ridiculed the suggestion that 20, 30, or 40 horsepower could be got at the rate of a penny per hour. As to a guaranteed run at 0.8 penny per hour it was impossible, and he was surprised that any seller circulated such a statement.

Mr. R. Buchanan, vice president, pointed out that it was only to be expected in view of the comparative novelty of gas engines that difficulty should arise. Many of them would disappear with greater familiarity.

Professor Burstall replying said that his own engine, a Premier, consumed one and three-quarters pints of oil per day, and developed 100 horsepower. There was no doubt that the crank shafts were too flimsy and they were always breaking. There was no doubt that the gas engine had been developed too quickly.

GRAB SYSTEM OF MINING AT THE GRANT MINE, BUHL, MINN.

Probably no one undertaking, or any one device, has been more commented upon by mining men during the past season than the opening up of the Grant mine and the grab system of stripping and mining installed there by Hoover & Mason. The apparatus, a rough sketch of which is shown in the accompanying illustration, is a familiar one in canal excavation, though built for that work on a considerably smaller scale, so far as span of cable and size of towers are concerned. In mining work, however, it is unique, and so criticism and comment upon this installation at Buhl, even though rather consistent in its unfavorableness, as it has been expressed up to this time, is to be recognized as based entirely upon observation of the performance at the Grant mine rather than upon operating experience.

A correct judgment as to the merits of the installation involves a number of considerations, arising out of the special terms upon which remuneration for the use of the apparatus is based, the objects in view both on the part of the builder of the machinery and the mining company, the extent and quality of the ore body and the necessity for a speedy shipment of the ore.

Grab Not to Displace Steam Shovel.

In the first place, it is to be understood that, contrary to the usual impression, this grab system has not been offered as a general substitute for the steam shovel methods of mining on the Mesabi range now in more or less satisfactory operation. It is a special device for a particular property built with the idea that the Grant mine, for which it was designed, could best be stripped and mined by such a system. The question of the disposal or removal of the gigantic towers and equipment, a much mooted question among those who have sought to compare the grab system with the steam shovel on a basis of economy, has been reduced to a minimum in significance, so far as either the builder or the Interstate Iron Co. is concerned, on the grounds that, compared with the value and quantity of the ore to be removed, the first cost of the apparatus will be of no consequence.

At the same time, it is, of course, the belief of the builders that there are other mines, also, so situated as to make the use of the grab system advantageous in their development, but, so far as the present installation is concerned, judgment as to its success is to be decided entirely upon the work at the Grant mine and upon the basis that the apparatus will lose its usefulness with the abandonment of the mine. That the installation may survive the mine and be in a condition for use elsewhere, and that the success of its operation will be sufficient to counterbalance the difficulties and necessarily large cost of moving the immense structure, is entirely problematical and outside of this consideration. In any case, that question only affects the builder of the machinery, who remains the owner of the apparatus.

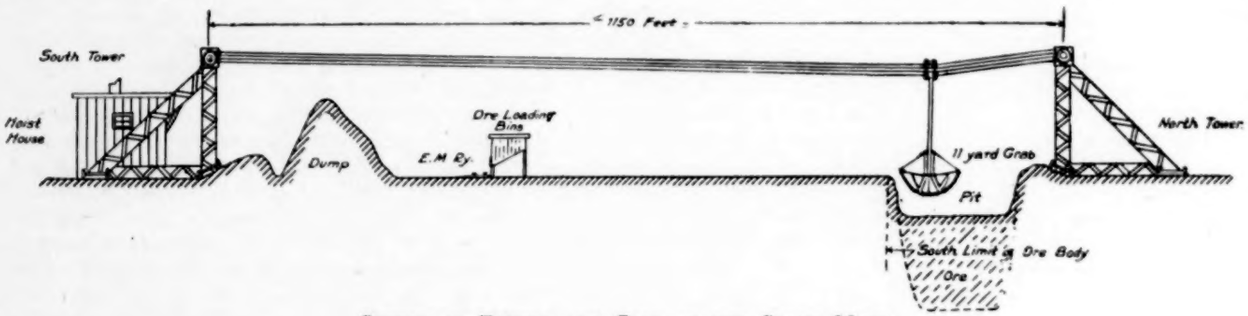
Terms of Builder's Contract.

From the standpoint of Hoover & Mason, the installation would probably not be considered an unqualified success as yet, largely because of the nature of the contract with the Interstate Iron Co., which controls the mine, and because of the numerous repairs to parts of the machinery, which the experimental nature of the design did not provide with requirements necessary to meet the unusual service demanded. Such information as has been vouchsafed concerning the agreement indicates that the stripping is being done on a basis analogous to a royalty contract, Hoover & Mason agreeing to erect and operate the grab which they have designed until a certain minimum yardage of dirt had been removed without cost to the mining company, after which the mining company is to pay a certain amount per yard of dirt or ton of ore removed, throughout the remainder of operations. This minimum yardage has, in the matter of its amount, a direct relation with the quantity necessary to be removed to permit the first shipment of ore, as estimated on the plan decided upon for opening the mine. It would seem evident, then, from the nature of the contract and from the fact that it was expected at the beginning of 1906 that ore would be shipped before the close of the season, that the builders believed the grab system capable of more than ordinarily rapid handling of dirt. It is probable, therefore, discounting all allowances which should be made because of the experimental nature of the new device, that expectations have not been realized in this regard. As for the mining company, it had not paid up to the close of 1906 one cent on the contract.

Description of Apparatus.

The apparatus consists of two latticed steel towers, placed 1,150 feet apart in a north and south direction, each 170 feet high over all, with 150 feet clear height under the cables and built by the Variety Iron Works, Cleveland. The upright and supporting members of the towers are skeleton steel columns, diverging downward from the cable sheave frame above, to form a tripod support which is as long parallel to the ground as the tower is high. Both towers are mounted on trucks, so that they may be moved bodily in an east and west direction along parallel rails laid for that purpose, so that access is had with the grab to an area of ground as long as the cable span and as wide east and west as the company's property.

The north tower is anchored with counterweights, and the power equipment for handling the grab is built on the south tower. This driving equipment consists of a 600-horsepower Westinghouse motor, capable of a 50 per cent overload, geared to the drums for winding the grab cables. The drums are controlled by a set of intricate Westinghouse friction brakes, having pneumatic valves electrically controlled. The entire control of the movements of the grab through this hoisting equipment is electrical and is



SKETCH OF TOWERS AND GRAB AT THE GRANT MINE.

handled by one operator from a small station alongside of the pit by a system of levers. The controlling mechanism is remarkable, especially in view of the unusual and racking variation in the load. When the grab is dropped into the pit and is just about to begin digging, the ammeter registering one moment no load will in the twinkling of an eye jump to 1,400 or 1,500 amperes, falling off as the lifting operation ceases to 500 or 600 amperes. These sudden changes of tension bring a tremendous strain on the driving gears, the noise accompanying being noticeable for several hundred feet and tax the braking capacity to the limit, in fact, beyond the efficient capacity of the brakes now installed, with the result that they will probably have to be replaced by larger and heavier ones. While the hoisting plant is giving noisy evidence of the strain under which it is operating, the load in all its strenuousness is being felt equally keenly in the engine room, but here, in contrast to the tower, scarcely a sound or an instant's variation in speed betokens the rapidly changing duty. Whatever else may be said of the installation, it certainly is true that the excellent quality and completeness of the entire equipment deserves every success possible. The power plant consists of two cross-compound Buckeye engines direct-connected to 400 kilowatt Crocker-Wheeler generators running at 150 revolutions per minute. For these units steam is supplied by five 72 x 18 return tubular boilers also built by the Variety Iron Works, Cleveland, all being enclosed in a fine brick power house.

The Rated Capacity of Grab.

The supporting cables for the grab are eight in number of 2¼-inch locked wire, the grab being suspended from a trolley frame so designed as to distribute through trolley wheels a part of the load to each cable. Separate and smaller cables control the opening and closing of the grab. In contrast to the immensity of the remainder of the structure, one cannot but notice the small size of the supporting pulleys on each tower for carrying the cables. It would seem that an excessive friction and wear on both cables and journals would result and it is not altogether unlikely that delays have arisen from that source. The grab itself is one of the largest ever built, being designed to have a capacity of 11 yards, which is equivalent to about 20 tons of ore. It is of the clam shell type, and the trays as originally constructed and used throughout the greater part of the past season, were built of heavy steel plates, but with no separate lip or cutting edge, which design it has been found necessary to remedy. The haul from the pit to the dump is about 1,000 feet, and the apparatus is designed to average a trip every three minutes. For a day of 20 hours, this would mean a capacity of 4,000 yards if the device worked up to its rating without delays, and assuming an average grab load of 10 yards, which would be a maximum average for an 11-yard bucket doing all that could be expected of it, or, in a month of 26 days, 104,000 yards.

From such an estimated yardage, however, a very considerable deduction should be made, in fairness, for the various natural delays incident to operation. The difference between the estimated and actual performance of a steam shovel stripping outfit covering a month's operation would seem to be a fair basis for such an allowance. Winston & Dear, stripping contractors, have probably made some of the best steam shovel records on the Mesabi range, and 60,000 yards per shovel per month is for them an excellent performance, yet by actual timing for a short period at the Monroe mine where Winston & Dear had a contract last year in a hard fine sand overburden, a by no means easy proposition, the monthly record should have been close to 84,000 yards based on one hour's observation. Other instances at the Stephens, Morris and Burt mines, where details of the timing of short performances could be given, show that the monthly quantity of dirt removed is often 30 and 40 per cent less than one might estimate.

Comparative Cost.

Making a conservative deduction, therefore, of 25 per cent from the figure 104,000, we find that on its rated performance the grab should remove 78,000 yards a month, which would be equivalent to a fair average performance for two steam shovels. On this basis, a comparison of operating expenses per month is interesting, though probably not an absolutely fair contrast, being somewhat favorable to the steam shovel:

Grab System.

Equipment	$350,000	
Interest at 4½ per cent		1,312
Depreciation at 7 per cent		2,042
Fuel cost (Approx.)		1,750
Salaries (25 men)		2,000
Monthly operating cost		$7,104

Two Steam Shovels.

EQUIPMENT.

2 shovels	$24,000	
4 locomotives	40,000	
40 dump cars at $300	12,000	
	$76,000	
125 men at $50		$6,250
Depreciation at 5 per cent		318
Interest at 4½ per cent		285
Fuel		950
Monthly operating cost		$7,803

While the above figures are not given as actual results, as shown by records, they form an approximate comparison, which indicates that, if the grab system could be operated up to its practical working rating of 78,000 yards a month, its operating cost would be slightly less than that of two shovels. The significant figure, however, in the comparison is the one of wages, a saving of over $4,000 a month being effected by the grab. It is this possibility, together with the various considerations attendant upon the waste pile end of the undertaking upon which the mining company bases its confidence in the ultimate success of the installation.

Advantages of Grab System.

The experience of mining operators in the Lake Superior region in the past few years has shown an increasing stringency in the supply of labor, and any solution of the mining problem which makes easier the handling of this branch is a distinct advance. In addition, therefore, to the saving in cost effected at the Grant mine, is the advantage of easy handling of men and the problem of labor supply. As regards the comparison in the matter of disposing of the dirt removed, it is well known that the arrangement of the dump of an open pit mine is half of the problem. The distribution of material, adequate area, the lay of the land, the obtaining of maximum height and capacity with minimum grades, the various difficulties in laying track and obtaining solid foundation, and the question of the approach and grade out of the pit are all entirely obviated by the use of the grab system. It is true, of course, that these problems are much more difficult of solution at some mines than others, and that the Grant mine would probably present difficulties not above the average. It has been thought by some that the fact that no approach at all has to be cut in this instance means a large saving, but it is to be remembered that in almost every case the approach is cut in ground under which there is ore, and which eventually will have to be stripped, so that the labor spent in cutting the approach is not lost. The distinct and unique advantages of the grab as regards waste pile are the height to which the dump may be built, being limited only by the clear height under the bucket, and the fact that the dump may be built on ground much closer to the pit than ordinarily possible, because of the absence of the problems of proper grading out of the pit, thus eliminating the time and cost of waste dirt transportation.

What the Grab Has Done.

In regard to the actual performance of the grab during the season of 1906, the apparatus is shown up in a less favorable light. The average time for a trip, as shown by a number of observations, is much nearer four minutes than three, and the amount of dirt which the bucket will take up with each grab averages more nearly eight yards than 10. On this basis, the monthly capacity would be 62,300 yards a month. However, the results of the season's work, which began about May 1, do not show even this performance. In explanation of this falling off from its normal rating, a number of things are to be mentioned. The over-

burden at the Grant mine consists on the surface of a sort of clay, under that boulders and sand, and below that a very fine sand approaching quick sand in quality. In handling the clay the grab operates excellently, as it undoubtedly will also when working in ore. The boulders are a little more difficult of handling, perhaps, though a large quantity of them were removed without trouble. It was found, however, that the trays, in striking these boulders when the grab was dropped into the pit, because of the fact that no cutting edge was provided in the design, leaving the steel plates to take the full shock, often cracked, necessitating new plates, so that a large number of delays arose from that source. It was decided later to fasten on a heavier and separate cutting edge, which it was expected would obviate entirely this difficulty. Some of the smaller boulders the grab would cut in two, but oftentimes a boulder would be caught between the two lips, so that the trays would be held open and although the grab would take up a load to the full capacity of the bucket, much of it would sift out before reaching the dump. This was particularly true when the digging operations reached the fine sand. The cause for much of the difficulty, however, lay in what seems to have been a faulty method of digging.

Method of Opening Mine.

According to the plan of working the mine, it was intended to get down to the ore as quickly as possible, and with as small a movement of overburden per ton of ore as practicable. The pit, therefore, was to be opened up to its present length, about 200 to 250 feet, and by the movement of the towers east and west to be opened up as wide as should be chosen, after which the ore should be entirely removed from this end of the deposit, the towers then moved in a northerly direction and the surface to be removed by the lengthening of the pit, dumped into the hole already made from which the ore was removed. This system has a large number of advantages, but as the pit has been dug up to this time, it would seem that it had not been made wide enough. It will be readily apparent that the grab, in taking up its load, would from the shape of scoop it made, and if there was not plenty of width in which to work, naturally dig an excavation which would slope toward the center of the pit from either side. This result is clearly shown, and as a consequence, the boulders loosened have rolled down to the center of the pit and congregated there in much larger numbers than they existed by natural placement in any one part of the stripping, a fact which has made the proposition considerably more difficult, as regards their handling, and has been responsible for a number of the breakages in the trays of the grab.

Another natural barrier to rapid work is foggy weather. The operator of the grab must be able to see it all the time from his situation alongside the pit, in order to make its working possible. For work at night, a large electric searchlight has been set up by means of which the movement of the grab can be followed through its entire length. This, however, is of no avail in the fog, and numerous delays have occurred for that reason.

First Season Not a Fair Trial.

Taken all in all, the season's work at the Grant mine presents some justification for the unfavorable comment as to its immediate success, but a great many of the difficulties that have been encountered in the beginnings will have been obviated before even a small percentage of the entire deposit is mined, and the full operation is bound to be more successful than that of the first season. The Interstate Iron Co. has not been embarrassed by the failure to ship ore from the Grant mine, which is the chief consideration, but, on the other hand, has been greatly gratified at the showing of the grab in matters where it has distinct advantages. The fairest statement that can be made with regard to it, if one will set aside for the time being the impression the first appearance of this immense equipment, with its large first cost gives, handling the same proposition where one has been accustomed to see smaller units, and perhaps more flexible methods in use, is that the past season has scarcely been a fair test and a suspension of judgment regarding the capabilities of this installation until a later time will probably induce more favorable opinions.

Dedication of the Engineering Building.—The program for the dedication of the building of the engineering societies in New York, April 16 and 17 has been partially prepared. The dedication ceremonies will take place Tuesday afternoon, April 16, and a reception will be held that evening. On Wednesday, April 17, Founder's Day, there will be a joint meeting of the three Foundry societies, at which there will be addresses by the presidents of the three societies and greetings from sister societies and institutions all over the world. Wednesday evening is unassigned. On Tuesday and Friday afternoons there will be professional sessions, and on Friday evening possibly a smoker, which will conclude the exercises of the week.

At the Lackawanna plant in Buffalo, the new No. 7 furnace was blown in Feb. 13; the No. 1 furnace was blown out Feb. 26.

SERIOUS OBJECTIONS

To a Tonnage Tax on Ore.—Interesting Facts Developed at an Investigation.

The question of a tonnage tax upon the iron ore output of Minnesota now before the Minnesota legislature and which had its beginnings in the message of Governor Johnson to the legislature at its convening, has aroused throughout St. Louis county, the part of the state chiefly affected by the changes proposed, a feeling which has waxed very warm and has brought out some interesting facts. The contention held by those supporting the movement for a tonnage tax upon ore shipments is that the state has not in the past received sufficient recompense for the great depletion of natural resources represented by the enormous amount of ore mined from St. Louis county in the past 15 years. According to the present system, the various townships have a rate of taxation upon all the property therein, including the iron ore mines, which will provide a return to the community commensurate with and in proportion to its indebtedness for school and other purposes, the amount necessary determining the tax rate. According to the plan proposed, the mines which now constitute a part of the township valuations are to be removed from that classification, and to be taxed per ton of output, by the state.

From the standpoint of the townships, which have uniformly opposed the proposition, it would mean that the remaining property, which, in most instances, constitutes the smallest part of the valuation, will have to be taxed at a much increased rate to maintain the present aggregate return, a condition almost ruinous to growth in some localities. From the standpoint of mine owners any system of taxation which distinguishes between their property and other property seems to them to be unfair, it being thought that the valuation of the mines, increases in which valuation have never met with objection when legitimately made, should take full reckoning of any differences between iron ore bearing property and others.

An investigating committee has been appointed by the legislature to make a tour of inspection on the range for the purpose of learning first-hand the actual conditions existing and to inquire from mining operators and officials the exact status of mining work and cost. In this connection much of interest has been brought to light. Particularly has the part which the Oliver Iron Mining Co. plays in the shipment of ore been dwelt upon, and it is gratifying to note that, in every instance, the influence of the Steel Corporation, as carried out in the workings of its subsidiary company, has aided

in developing a tendency to sustained improvement and soundness in both mining and market conditions. To begin with, the Oliver Iron Mining Co. sells its ores, as does any other mining company, at regular market rates and upon leases which are oftentimes made on a sliding scale based on the market price of ore, a situation most considerate of the fee owners. Through the influence of the Steel Corporation, prices have been maintained higher than before its existence, and the average profits to the Oliver Iron Mining Co. per ton of ore mined are pointed out to have been as low or lower than those of any other shipper.

It was also pointed out in connection with the agitation for a tonnage tax that the cost of mining low grade ore is liable to be quite as great as the cost of mining the best quality; that Mesabi range ores are a consideration entirely independent of other ores of other portions of the Lake Superior district, because of the less valuable physical qualities of these ores for furnace purposes. Figures quoted as coming from an official of the Oliver Iron Mining Co. gave some idea of the immense cost of developing a mine, and made reference to the Monroe-Tener mine, which, in its development up to the end of 1906, had cost $1,500,000. This mine, however, has been opened up underground, being part underground and part milling pit, in a splendid and precise manner only possible with such an ore body as the Monroe-Tener has and where operations will undoubtedly extend over a large number of years. It is probable, therefore, that the $1,500,000 represents an outlay somewhat larger in proportion to the amount of ore already shipped than is ordinarily true where preparations are not being made to cover operations for so extended a period of time. It is stated that the opening up of the Gilbert mine will cost $800,000 before any shipment is begun, and that the development of the McKinley mine will cost in the neighborhood of $275,000. Attention was directed to the Canisteo district, of which mention has already been made in these columns, where just to build a railroad line in, meant an outlay of $4,000,000, and where all the cost of development would be for the purpose of shipping and mining ore of quite low grade, most of which would have to be washed, and which will, because of its sandy nature, require a per ton outlay much larger than the per ton cost of mining many other properties, which, according to the tonnage tax scheme, would be asked to give no greater return to the state.

It was declared that the great amount of comment upon the so-called Hill ores, to which Mr. Hill has given, in his statements, a value of a dollar a ton in the ground, has created a wrong impression regarding the real value of ore. A great deal of ore in quantity has been purchased at from two to 10 cents per ton, and the average royalty being paid by the Steel Corporation is 26 cents, which is perhaps larger than the average royalty per ton being paid by independent operators. It was also explained, by pointing out the self-evident reason, how properties purchased outright at a price indicating a payment of from two to 10 cents per ton of ore were equivalently paid for in payments of from 25 to 30 cents royalty per ton, because of the interest accumulations on the purchase price, which, running through the term of a royalty lease, would bring the aggregate sums at the end of a period of years up to equivalent amounts.

Regarding the various items entering into the value of ore at Lake Erie ports, the following figures were given, which indicated an average profit to the Steel Corporation last year of about 75 cents per ton: The cost of mining outside of royalty, 70 cents; average royalty, 26 cents; rail freight, 80 cents; lake freight, 75 cents; marine insurance, 1 cent; depreciation on plant and mine, 20 cents; taxes, 5 cents; interest, 2 cents; total, $2.79, Cleveland docks.

The base price of Mesabi Bessemer ore at Lake Erie ports for last year, to which the above figures apply, was $4.00, and for non-Bessemer $3.75. The Oliver Iron Mining Co. sales of ore contracted for under long time contracts and based on the analysis of the ore were probably for less than that price, so that the profit was about as stated above.

Iron Ore of Canada.—The Ontario department of mines has issued a report giving the mineral production of the province for 1906, which shows a net total in value of $22,221,808 as compared with $17,854,296 for 1905, or about 25 per cent increase. The output of iron ore was 128,099 tons valued at $301,032. Pig iron was produced to the amount of 275,558 tons of the value of $4,554,247. The quantity of Ontario's iron ore smelted into pig iron in the province was 101,569 tons, valued at $243,766.

The Worcester branch of the National Metal Trades Association held its annual meeting Feb. 28. The following officers were re-elected: George F. Brooks, president; Edward M. Woodward, vice president; J. Philip Bird, treasurer. Members of the executive board chosen were: John R. Back, Frank L. Coes, of Worcester; Charles Fosdick, of Fitchburg, and Charles D. Harrington, of Southbridge. The reports submitted show a large increase in membership during the past year, and also a substantial balance in the treasury.

NEWS FROM BLAST FURNACES.

The furnace of the Nittany Iron Co., Nittany, Pa., is out for relining.

No. 3 furnace of the Pennsylvania Steel Co. was out of blast for relining last month.

One furnace of the Allentown Rolling Mills was idle through the entire month of February.

The Carnegie Steel Co.'s Steubenville furnace has been out of blast all of the month of February for relining.

One furnace of the Marting Iron & Steel Co., Ironton, O., was banked two days during February for want of coke.

The furnace of the Embree Iron Co., Embreeville, Tenn., was off 17 days during February on account of lack of fuel.

The charcoal iron furnace of the Eagle Iron Co., Attalla, Ala., is again in blast and making an average of 80 tons a day.

The Belfont Iron Works, Ironton, O., was compelled to shut down its furnace for two days last month because of coke shortage.

The Zenith furnace at Duluth was blown out on the last day of the month, and will be out for a short time in order to make repairs.

No. 1 Paxton furnace of the Central Iron & Steel Co. was out of blast 12 days during February while the furnace bosh was being relined.

During the last week of the month the Musconetcong Iron Works had considerable trouble with its furnace, diminishing somewhat the production.

The furnace of the Rockdale Iron Co., out of blast during February, will continue so through March, but will be ready for work by April 1. It is being relined.

The Soho furnace of the Jones & Laughlin Steel Co. was blown out for relining and general overhauling on March after having made 411,381 tons of low-silicon, Bessemer and basic iron, the largest proportion being basic.

The furnace of the Spring Valley Iron & Ore Co., Spring Valley, Wis., was blown out Feb. 21 for relining and to permit the building of a 40-foot extension to the stove's chimney. The stack will probably be blown in again about March 15.

The Central Iron & Coal Co., operating the Holt furnace at Tuscaloosa, Ala., is adding materially to its mine equipment, being in receipt of a No. 3 Thew automatic steam shovel to be used at its Woodstock brown ore mines. The delivery of a third large three-stage, Ingersoll-Sergeant air compressor, a compound air locomotive built by H. K. Porter & Co. and a duplex pump built by the Herron Pump & Foundry Co., Chattanooga, to be used at its Kellerman, Ala., coal mine is expected in the near future.

THE ART OF CUTTING METALS[1]

(Continued from last week.)

By Fred W. Taylor.

HOW LONG SHOULD A TOOL RUN BEFORE REGRINDING?

The Effect Upon the Cutting Speed of the Duration of the Cut; i. e., the Time Which the Tool Must Last Under Pressure of the Chip Without Being Reground.

The following are the principal conclusions arrived at on this subject, regarding the duration of the cut:

(A) For a practical table showing how long each sized tool should be run before being reground, table 82.

(B) The reasons for running tool the length of time given in the practical table referred to in conclusion A are given below.

(C) If we note the proper cutting speed for a tool which is to last 20 minutes, and wish to find the cutting speed for a tool to last 40 minutes, multiply the 20-minute cut by 0.92.

(D) If we have the proper cutting speed for a tool to last 20 minutes, and wish to find the proper cutting speed for a tool to last 80 minutes, multiply the 20-minute cut by 0.84.

(E) For a practical table giving the ratios between the cutting speeds corresponding to different durations of cut, see table 83.

(F) For formula from which practical table in (A) was made up, see table 84, diagram Fig. 85, and description below.

(G) The same relation exists between the duration of the cut and the cutting speed for steels of different degrees of hardness.

(H) No scientific or correct conclusions can be drawn from tests in the art of cutting metals in which cuts of much shorter duration than 20 minutes are used.

(J) We have been unable to accurately determine the relation between the duration of the cut and the cutting speed for tools used in cutting cast iron. Such laws are badly needed.

(K) For the relation of the duration of cut to cutting speed when carbon tempered tools are used, see table 86, diagram Fig. 87.

(L) Modern high speed tools do a much larger amount of work without regrinding than carbon tempered tools.

We have already called attention to the fact that as a measure of the value of a tool, the length of time which a tool can be run without being reground is a false and worthless standard; and we have called particular attention to the radically different kind of wear which occurs with tools that last only a short while under cut and those which last for a longer time. Briefly restated, the reason for this is that in order to have it last a long time, any given tool must be run at so slow a cutting speed as to waste the time of both the machinist and the machine. The small saving in grinder's wages, in the wages of the smith and in tool steel, which is made by having a tool last a very long time, is much more than overbalanced by the diminished output of the machine which corresponds with the slow cutting speed. So little, however, is the effect of the duration of the cut upon the cutting speed generally understood that probably not one machinist in a thousand realizes that there exist clearly defined laws as to the effect of the duration of the cut on the cutting speed. It is also safe to say that for the purpose of avoiding frequent grinding it is the almost universal practice in machine shops to run tools at cutting speeds which are entirely too slow for maximum economy, when all of the elements bearing upon this subject are properly considered. And indeed this and the various other laws together present a problem which is so complicated that no mechanic or even mathematician can quickly and correctly solve it without the use of slide rules. Even with the slide rules but comparatively small gain will be made unless the older type of management has been superseded by the system of task management with its accompanying aids in the form of functional foremanship, written instructions and its various safeguards.

Several series of careful experiments have been made by us at different times to investigate the precise effect of the duration of cut upon the cutting speed. The first of these was made in 1883 at the Midvale Steel Works, with carbon tempered tools, both when the tools were run dry and when they were run under a heavy stream of water. The summary of the results of these experiments will be described below.

Effect Upon Cutting Speed of Duration of Cut, Modern High Speed Tools Being Used.

The only experiments which are of practical interest in this field are those made with modern high speed tools.

Table 84 gives a summary of one set of experiments in which the important details of each tool trial are entered. Un-

[1]Presidential address, A. S. M. E., 1906.

Table 82.—Data From Which to Decide How Long a Tool Should Run Before Being Reground.

Periods of time given in these columns for redressing, grinding and changing tools were determined by many stop-watch observations. In the column headed **t** are given the equivalents in the time of the machine operator and his machine and the total time for redressing, grinding and setting and the tool steel lost each time the tool is reground.

SIZE OF BODY OF TOOL IN INCHES	TIME TO REDRESS TOOL IN MINUTES	NUMBER OF REGRINDINGS FOR EACH REDRESSING	PROPORTIONATE TIME OF REDRESSING FOR EACH REGRINDING IN MINUTES	A PROPORTIONATE TIME OF REDRESSING FOR EACH REGRINDING CONVERTED INTO EQUIVALENT TIME FOR MACHINE	TIME TO GRIND TOOL IN MINUTES	B TIME TO GRIND, CONVERTED INTO EQUIVALENT TIME FOR MACHINE	COST OF TOOL STEEL LOST FOR EACH REDRESSING IN CENTS	COST OF TOOL STEEL FOR EACH REGRINDING IN CENTS	C COST OF TOOL STEEL FOR EACH REGRINDING CONVERTED INTO EQUIVALENT TIME FOR MACHINE	D TIME LOST IN CHANGING TOOL IN MACHINE IN MINUTES	t EQUALS SUM OF COLUMNS A, B, C & D IN MINUTES	T − 7t TIME TOOL MUST RUN BEFORE REGRINDING IN ORDER TO DO A MAXIMUM OF WORK TIME IN MINUTES	10t TIME IN MINUTES	TIME WE RECOMMEND THAT TOOL BE RUN BEFORE REGRINDING, THAT IS, 10t IN EVEN FIGURES, IN HOURS AND MINUTES	SIZE OF BODY OF TOOL IN INCHES
¾ × 3	8.8	13	0.677	1.130	2.2	3.67	9	0.69	1.38	1.5	7.7	54	77	1—15	¾ × 3
¾ × 4	9.2	15	0.613	0.766	2.4	3.00	17	1.13	1.69	1.6	7.0	49	70	1—15	¾ × 4
1 × 1½	9.7	17	0.571	0.571	2.6	2.60	30	1.76	2.11	1.7	7.7	54	77	1—15	1 × 1½
1 × 1½	10.3	18	0.572	0.477	2.8	2.33	47	2.61	2.61	2.8	8.2	57	82	1—30	1 × 1½
1 × 1½	11.0	19	0.579	0.414	3.0	2.14	70	3.68	3.16	3.0	8.7	61	87	1—30	1 × 1½
1¼ × 1½	12.7	20	0.635	0.353	3.6	2.00	137	6.85	4.57	3.3	10.2	71	102	1—45	1¼ × 1½
1¼ × 2½	14.8	20	0.740	0.336	4.3	1.95	236	11.80	6.44	3.6	12.3	86	123	2—00	1¼ × 2½
1¼ × 2½	17.2	20	0.860	0.331	5.1	1.96	375	18.75	8.66	4.0	15.0	105	150	2—30	1¼ × 2½
2 × 3	20.0	20	1.000	0.333	6.0	2.00	448	22.40	8.96	4.5	15.8	110	158	2—45	2 × 3

derneath each set of trials we give our conclusion as to the correct cutting speed corresponding to the given duration of cut. In these experiments, tools made of the following chemical composition were used:

Tungsten	8.50 per cent
Chromium	2.00 per cent
Carbon	1.85 per cent
Manganese	0.15 per cent
Silicon	0.15 per cent

In the test made upon our standard tools, the shapes indicated in Fig. 23 were used, ground to the following angles: Clearance, 6 degrees; back slope, 8 degrees; side slope, 14 degrees. Each tool had previously been standardized upon a forging of as uniform steel as we could obtain, so as to prove all of the tools to be approximately uniform in their cutting speeds. A test piece of annealed steel about 24 inches in diameter and 10 feet long, having approximately the following chemical composition and the following physical test, was used for making the trial.

CHEMICAL COMPOSITION OF FORGING.

Carbon	0.34
Manganese	0.60
Silicon	0.183
Phosphorus	0.035
Sulphur	0.032

PHYSICAL PROPERTIES OF FORGING.

Tensile strength	71,300 pounds
Elastic limit	32,590 pounds.
Extension	29.00 per cent.
Contraction	49.57 per cent

In Fig. 85 are plotted the summarized values given in table 84, and a curve approximating these values is drawn on the diagrams. This curve is represented by the following formula:

$$V = \frac{90}{T^{\frac{1}{4}}}, \text{ in which}$$

V = speed of the tool in feet per minute;

T = length of time tool must last without grinding.

The data expressed in this formula and by this curve may be given also in the following form. If we know the proper cutting speed for a tool which is to last 20 minutes, and we wish to find the cutting speed for a tool to last 40 minutes, multiply the 20-minute cutting speed by 0.92, and if we have the proper cutting speed for a tool to last 80 minutes, multiply the 20-minute cutting speed by 0.84.

A glance at these figures will show the material gain in cutting speed which can be made by grinding tools every 20 minutes, say, instead of grinding them every 80 minutes. It will be noted that in this table and formula we have included cuts of as short duration as 10 minutes. It is proper, however, to call attention to the fact that the duration of 20 minutes is the shortest running time from which it is safe to draw any correct scientific conclusions from tests in the art of cutting metals. The reasons for this statement will be found under the heading of "The nature of wear on tools depends upon whether it has been chiefly caused by heat,"[2] and under the heading "Reason for adopting the standard test period of 20 minutes."[2]

There are certain classes of experiments, however, in which it is of great advantage to have even an approximate idea of the relation between the cutting speed of a tool which gives out in 10 minutes and that of tools which will last through a longer period; and it is for this reason that we have included the 101-minute period in our law; although we

[2] IRON TRADE REVIEW, Jan. 10, 1907.

TABLE 84.—THE EFFECT ON CUTTING SPEED OF TIME TOOL IS UNDER CUT IN CUTTING STEEL.

Feed $\frac{1}{16}$" Depth of Cut $\frac{1}{4}$" $\frac{3}{4}$" Standard Round Nose Tool. Clearance Angle 6°, Back Slope 8°, Side Slope 14°. See Folder 8, Fig. 24.

10 MINUTE RUNS					20 MINUTE RUNS					40 MINUTE RUNS					80 MINUTE RUNS				
Reference Number	Mark on Tool	Speed in Feet	Duration of Cut	Condition of Tool	Reference Number	Mark on Tool	Speed in Feet	Duration of Cut	Condition of Tool	Reference Number	Mark on Tool	Speed in Feet	Duration of Cut	Condition of Tool	Reference Number	Mark on Tool	Speed in Feet	Duration of Cut	Condition of Tool
14535	29PRL	98 8	10 0	G	14558	2709ME	60 5	20 0	G	14565	106PRL	50 0	40.0	G	14928	1945KE	46.75	49.0	R
14536	C1939ME	99 6	10 0	G	14559	196PRL	61 5	20 0	G	14566	126PRL	52 0	40.0	G	14931	C2709ME	51.5	80.0	G
14537	C1903ME	63 2	10 0	G	14560	176PRL	60 3	20 0	G	14567	107PRL	55 4	22.7	R	14933	C2092ME	49 9	80 0	G
14538	C2652ME	65 7	10 0	G	14561	106PRL	60 5	20 0	G	14568	115PRL	52 0	40.0	G	14935	C2787ME	52 5	80 0	G
14539	C2721ME	66 4	10 0	G	14562	C1945ME	61 0	20 0	G	14872	C1945ME	52 5	40 0	G	14936	126PRL	52 0	40 0	R
14540	C2709ME	71 1	10 0	G	14563	2709ME	63 4	9 0	R	14877	106PRL	56 9	40 0	G					
14541	C1939ME	72 6	4 5	R	14564	176PRL	62 5	18 1	R	14878	126PRL	56 2%	40 0	G					
14542	C1903ME	70 0	5 5	R						14882	106PRL	55 2	14 4	R					
14543	C2721ME	70 0	3 8	R						14883	115PRL	60.28	40 0	G					
14544	C2655ME	67 5	1 8	R						14886	156PRL	54 3	12 1	R					
14545	C2709ME	70 0	2 0	R						14887	C1945ME	55 2	40 0	G					
Conclusion		67	10	6	Conclusion		62	20	6	Conclusion		58.5	40	6	Conclusion		51.5	80	6
Cutting Speed Figured by the Formula $V = \frac{90}{T^{\frac{1}{4}}}$																			
67.5					61.9					58.7					52				

TABLE 83.—PRACTICAL RULE SHOWING EXTENT TO WHICH CUTTING SPEED OF HIGH SPEED TOOL MUST BE SLOWED DOWN TO HAVE IT LAST LONGER WITHOUT REGRINDING.

IF WE HAVE THE PROPER CUTTING SPEED FOR A CUT LASTING	WE FIND THE SPEED FOR A CUT LASTING	BY DIVIDING BY	OR BY MULTIPLYING BY
20 minutes	40 minutes	1.09	0.92
40 minutes	80 minutes	1.09	0.92
20 minutes	80 minutes	1.19	0.84
40 minutes	20 minutes	0.92	1.09
80 minutes	40 minutes	0.92	1.09
80 minutes	20 minutes	0.84	1.19

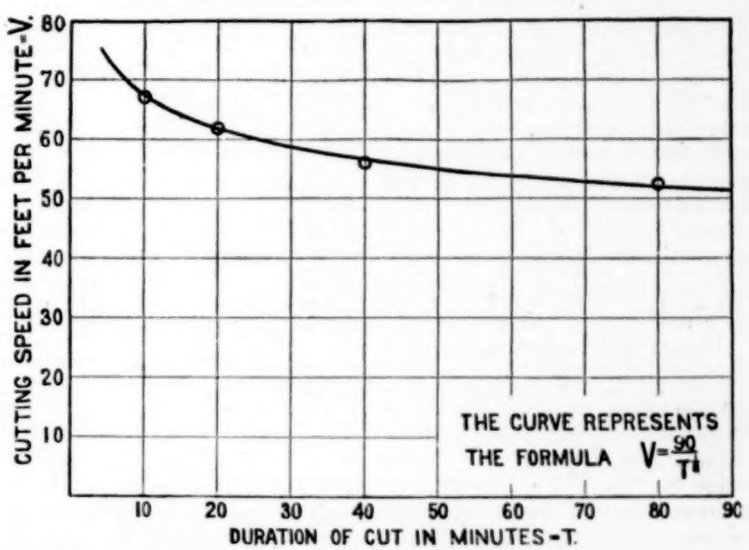


FIG. 85.—DIAGRAM GIVING SUMMARY OF EXPERIMENTS IN TABLE 84.

wish it distinctly understood that the same value does not attach to the 10-minute figures as to those corresponding to 20 minutes duration and upward.

We have made a number of experiments upon the effect of the duration of cut on cutting speed with different qualities of steel, and find that approximately the same relation exists between the duration of cut and cutting speed for steels of different degrees of hardness. This statement, however, does not apply to cast iron.

Effect Upon Cutting Speed of Duration of Cut, Carbon Tempered Tools Being Used.

In table 86 and Fig. 87 are given the results of a similar experiment tried with carbon tempered tools. The steel

T = TIME TOOL WAS UNDER CUT IN MINUTES	F = FEED IN INCHES	CUTTING SPEED FROM EXPERIMENTS IN FEET AND INCHES PER MINUTE	CUTTING SPEED BY THE FORMULA IN FEET PER MINUTE $V = \frac{11.3}{F^{0.65}T^{\frac{1}{5}}}$
20	0.050	4'— 8"	4'.35
	0.059	3'—11"	3'.9
	0.084	3'— 1"	3 .1
40	0.050	3'—9"	3 .8
	0.059	3'—6"	3 .4
	0.084	2'—8"	2 .7
80	0.050	3'—3"	3 .3
	0.059	3'—0"	2 .96
	0.084	2'—5"	2 .35

TABLE 86.

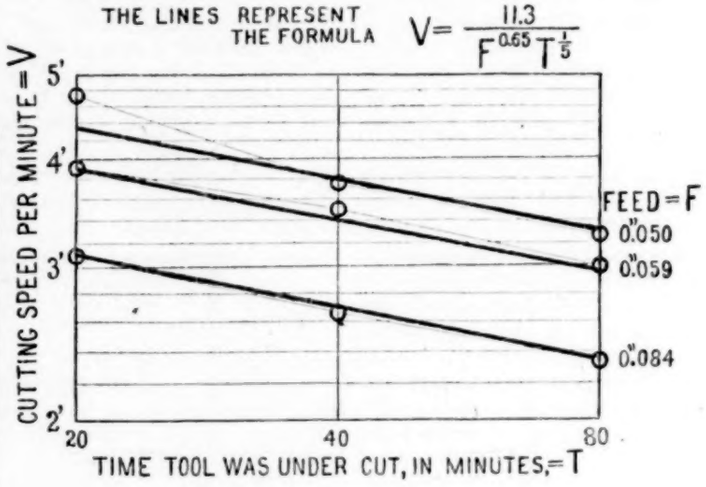


FIG. 87.

THE EFFECT ON CUTTING SPEED OF VARYING THE TIME TOOL IS UNDER CUT.

Experiments made with ¾ x 1¾-inch carbon tempered, round nosed roughing tool; clearance angle 5 degrees; back slope 8 degrees; side slope 14 degrees; depth of cut 3-16-inch. Experiments plotted on logarithmic paper in Fig. 86; experiments made at Midvale Steel Co., Philadelphia, 1883.

Composition of steel tire: carbon 0.58; manganese 0.66; silicon 0.20; phosphorus 0.036. Physical properties of tire: tensile strength 118,543 pounds; extension 14.5 per cent.

which was cut was in this case a large locomotive tire. A practical rule resulting from these experiments is:

If we know the proper cutting speed for a tool which is to last 20 minutes, and we wish to find the cutting speed for a tool to last 40 minutes, multiply the 20-minute cutting speed by 0.87 or divide it by 1.15. And if we have the proper cutting speed to last 20 minutes and we wish to find the cutting speed for a tool to last 80 minutes, multiply the 20-minute cutting speed by 0.76 or divide it by 1.32.

Effect Upon Cutting Speed of Duration of Cut, with Modern High Speed Tools and Carbon Tools Compared.

A comparison of the following figures will show that the high speed tools fall off less in their cutting speed than the carbon tool, when they are run for a long time, since with tempered tools an 80-minute cut is 24 per cent slower than a 20-minute cut, while with the modern high speed tools an 80-minute cut is only 16 per cent slower. The following table shows the increased durability of the new high speed steels even when they are run at their proper cutting speeds.

DURABILITY OF HIGH SPEED STEELS.

	DURATION OF CUT		AN 80-MINUTE CUT IS FOLLOWING PER CENT SLOWER THAN A 20-MINUTE CUT
	20 MINUTES	80 MINUTES	
HIGH SPEED TOOLS, CUTTING SPEED	99 ft. per minute	83 ft. per minute	16 per cent
CARBON TEMPERED TOOLS, CUTTING SPEED.	16 ft. per minute	12 ft. per minute	24 per cent

Effect Upon Cutting Speed of Duration of Cut in Cutting Cast Iron.

We have made several attempts to accurately determine the law governing the effect of the duration of cut upon cutting speeds when tools were used upon cast iron. These experiments have up to date, however, been uniformly unsuccessful, because we have failed to obtain a sufficiently large and uniform body of cast iron to enable us to make the number of tests required for an accurate determination of the law. In general, however, it may be said that those tests which we have made indicate that tools are even more enduring in cutting cast iron than in cutting steel; *i. e.*, that there is a smaller percentage of falling off in cutting speed between a 20 and an 80-minute cut in cast iron than there is with the corresponding cuts in steel.

How Long Should a Tool be Run Without Regrinding?

Perhaps the most important practical decision to be made after studying the laws of the effect of the duration of cut upon the cutting speed, all things considered, is: What is the most economical length of time for running each sized tool before regrinding it?

It is clear that we have on the one hand the main fact that the more often we are willing to grind the tool the higher the cutting speed at which the tool can be run, and therefore the larger the amount of work which will be turned out by the machine. On the other hand, there are four opposing considerations, all of which tend toward a greater expense the more frequently the tools are ground. These considerations are:

(A) The time required to remove the worn-out tool from the tool-post; get another sharp tool; set and clamp it into the tool post; and again start the roughing cut to exactly the proper size. For exact figures see table 82.

(B) The time of the tool grinder and the grinding machine and the wear on the emery wheel each time a tool is ground, which can be expressed in terms of the time of the lathe hand and his lathe time. For exact figures see table 82.

(C) The cost of the smith's and helper's wages, and fire, blast, etc., in the smith shop, for dressing a tool; which cost should be divided by the total number of times the tool is ground before it requires redressing. And this fraction of the dressing cost can then be expressed also in terms of the time of the lathe hand and his lathe. For exact figures see table 82.

(D) The cost of the tool steel which is lost every time a tool is redressed. This cost should also be divided by the

total number of times the tool is ground, and expressed in terms of the time of the lathe hand and lathe. For exact figures see table 82.

This problem has been put into definite mathematical form and solved by us as follows: Let us assume that the cost of the grinder's wages plus the cost of the grinding machine is the same per hour or minute as the cost of the lathe in which the work is being done plus the wages of the lathe hand for lathes using certain sized tools; and that for lathes using larger sized tools the grinding machine cost is proportionally smaller, while for lathes using smaller tools the grinding machine cost is proportionally larger. Also, in a similar way the cost of the smith and his helper and of the fuel are expressed in terms of the time of the lathe hand and his machine, as stated above. This enables us then to arrive at the following mathematical solution of the problem.

In table 82, we have given the time required to dress and grind the various sized tools, and also the time required to place them in the machine, remove them from the machine, and start the cut. These data have been compiled from accurate observations made in each case by a competent observer with a stop watch, while the grinder, the lathe hand, and the smith were working at their proper normal speeds. In the same table we have also given the average number of times that each of the sizes of our standard tools can be reground before requiring to be redressed. The cost of the tool steel used each time a tool is dressed is also found in the same table.

The Most Economical Duration of the Cut in Cutting Steel.

The following formula shows the relation between the cutting speed V and the length of time T that the tool will last before requiring to be reground.

$$\frac{V}{V_o} = \left(\frac{T_o}{T}\right)^{\frac{1}{8}} \qquad [A]$$

Solving this for V we get:

$$V = V_o \frac{T_o^{\frac{1}{8}}}{T^{\frac{1}{8}}} = \frac{\text{Constant}}{T^{\frac{1}{8}}} = \text{Constant} \times T^{-\frac{1}{8}} \qquad [B]$$

for any given hardness of metal and efficiency of tool.

Let t = the sum of the four periods of time $A + B + C + D$ described in the two final paragraphs of the last section. Let us then look upon the time t as if it were all time lost or necessarily wasted by the lathe hand and his machine after he has run his tool continuously for T minutes; or, in other words, let us assume that, during a period of $T + t$ minutes the tool will be cutting for T minutes and then give out, and that the machine, as a consequence, will be laid idle during the remaining t minutes.

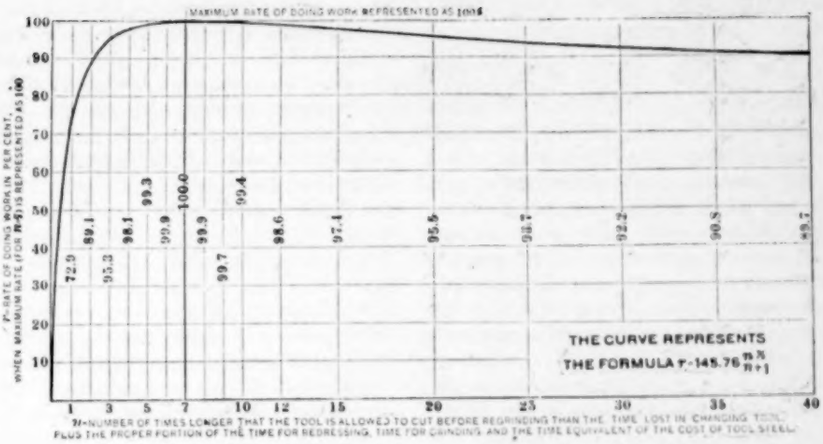

MAXIMUM RATE OF DOING WORK REPRESENTED AS 100%
r = RATE OF DOING WORK IN PER CENT. WHEN MAXIMUM RATE (FOR n = 7) IS REPRESENTED AS 100
72.9
89.1
95.3
98.1
99.3
100.0
99.9
99.7
99.4
98.6
97.4
95.5
93.7
92.2
90.8
89.7
THE CURVE REPRESENTS THE FORMULA r = 145.76 n^7/8 / n+1
n = NUMBER OF TIMES LONGER THAT THE TOOL IS ALLOWED TO CUT BEFORE REGRINDING THAN THE TIME LOST IN CHANGING TOOL PLUS THE PROPER PORTION OF THE TIME FOR REDRESSING, TIME FOR GRINDING AND THE TIME EQUIVALENT OF THE COST OF TOOL STEEL.

FIG. 28.—LENGTH OF TIME A TOOL SHOULD RUN WITHOUT REGRINDING.

Diagram shows that in order to do the largest amount of work for the lowest all around cost, a tool should be allowed to cut continuously without grinding at least seven times the time lost in changing tool, plus the proper portion of the time for redressing, time for grinding and the time equivalent to the cost of the tool steel.

Now, the cutting speed of the tool being V, the quantity or weight of metal W removed (in the total time $T + t$) must be directly proportional to the product VT; that is,

$$W = \text{Constant} \times VT \qquad [C]$$

Let r = the average rate at which the metal is removed during the whole period $T + t$, then we have

$$r = \frac{W}{T+t} = \text{Constant} \times \frac{VT}{T+t} \qquad [D]$$

But we have seen, formula [B], that $V = \text{Constant} \times T^{-\frac{1}{8}}$ which substituted in formula [D] gives

$$r = \text{Constant} \times \frac{\text{Constant} \times T^{-\frac{1}{8}} \times T}{T+t} = \text{Constant} \times \frac{T^{\frac{7}{8}}}{T+t} \qquad [E]$$

Let n = the number of times t is contained in T then we have

$$T = nt \qquad [F]$$

and substituting [F] in [E], we have

$$r = \text{Constant} \times \frac{(nt)^{\frac{7}{8}}}{nt+t} = \text{Constant} \times \frac{n^{\frac{7}{8}} t^{\frac{7}{8}}}{(n+1)t} = \frac{\text{Constant}}{t^{\frac{1}{8}}} \times \frac{n^{\frac{7}{8}}}{n+1} \qquad [G]$$

n	0	1	2	3	4	5	6	7	8
Per cent of Max.	0	72.9	89.1	95.3	98.1	99.3	99.9	100	99.9
n	9	10	12	15	20	25	30	35	40
Per cent of Max.	99.7	99.4	98.6	97.4	95.5	93.7	92.2	90.8	89.7

However, for any given tool, t is also a constant, and we finally get from [G]

$$r = C \times \frac{n^{\frac{7}{8}}}{n+1} \qquad [H]$$

in which C is a complex constant.

Assuming successive values for n from 0 up, we get the following corresponding values for the expression $\frac{n^{\frac{7}{8}}}{n+1}$, to which the corresponding values of the rate r are proportional.

n	0	1	2	3	4	5	6	7	8
$\frac{n^{\frac{7}{8}}}{n+1}$	0	0.5000	0.6119	0.6538	0.6728	0.6815	0.6852	0.6862	0.6854
n	9	10	12	15	20	25	30	35	40
$\frac{n^{\frac{7}{8}}}{n+1}$	0.6839	0.6817	0.6766	0.6683	0.6549	0.6432	0.6326	0.6234	0.6152

We thus see that the rate r increases very rapidly with n, to begin with; reaches a maximum for $n = 7$, is not far from this maximum for n as low as 5, and remains close to this maximum as far as $n = 10$, and even beyond this falls off at a very slow rate only.

If we put the value of the maximum rate ($r_m = C \times 0.6862$) equal to 100, we get the following table of the other rates corresponding to the various values of n in per cent of this maximum rate (for $n = 7$), by multiplying $\frac{100}{0.6862}$ by the various values of $\frac{n^{\frac{7}{8}}}{n+1}$.

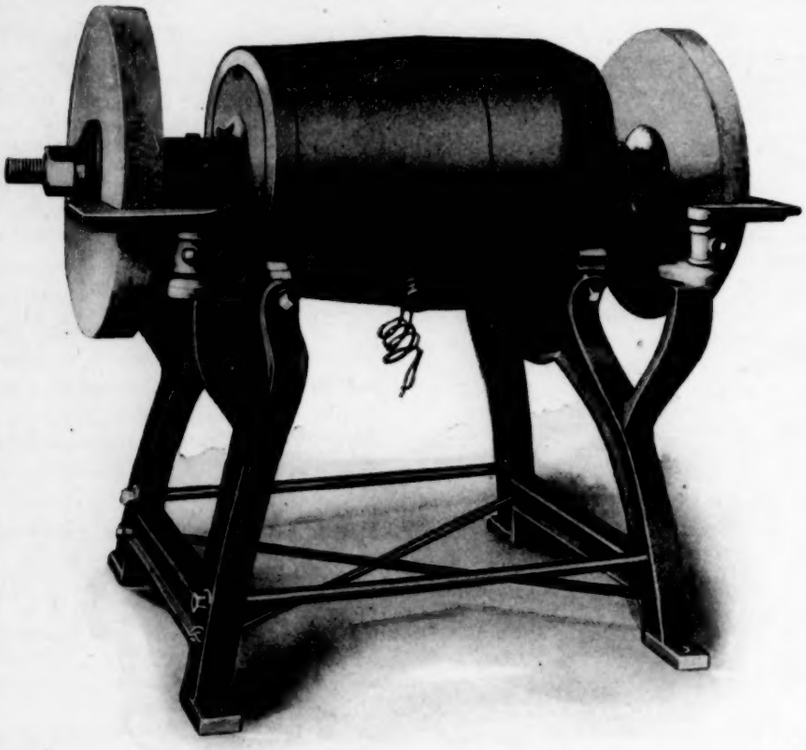
This table of rates of removing the metal in per cent of the maximum rate is graphically represented by the diagram Fig. 88.

(To be Continued.)

The Santa Fe system is completing large extensions to its shop at Topeka, Kas. Among the additions erected are car repair shops, structural steel repair shop, power house and planing mill, wheel shop and dry kiln.

THE BULLDOG ELECTRIC GRINDER.

The bulldog electric grinder being placed on the market by J. Wendell Cole, Columbus, O., is shown in the accompanying illustration. It is made both in the constant speed and variable speed types, which are, however, similar in external appearance. The great majority of electric grinders are modifications of the belt-driven pattern, so arranged as to accommodate an electric motor. The one shown here is designed primarily for a 5-horsepower motor. It has a heavy arbor, 9-inch journals with double ring oilers and oiling pockets in the journal boxes. The arbor shaft is extended at both ends to carry 24-inch emery or other abrasive wheels. The motor case frame is heavy and is provided with cylinder heads to carry the journal boxes. The starting rheostat is enclosed in the motor frame, the handle being shown projecting below.



THE "BULL DOG" ELECTRIC GRINDER.

To support the motor case frame, legs weighing over 400 pounds are provided, these being bolted fore and aft and diagonally at the base. This gives a rigid base and a strength equal to a box column base with considerably less material. The leg frames encircle the motor case for one-third of its circumference, and from the legs are projected rest arm braces.

The maker claims the following advantages for the machine: The bearings are more rigidly supported by the cylindrical frame than the bearings in the ordinary type of grinder; by removing the sheet iron casing all interior portions of the motor are easy of access; the motor of the grinder is made larger than in ordinary grinders of the same capacity, and consequently will run cooler than the lighter and smaller machines; the weight of the motor and supporting frame is placed where it is the most useful.

By means of a pair of special commutating poles and a field rheostat, a variable speed grinder is obtained with a range of from 925 to 1,500 revolutions per minute. This range can be obtained from the lowest to the highest in about 50 steps. The ideal condition for the grinder is a peripheral speed of the wheel of about one mile per minute, and by the use of a variable speed motor this peripheral speed may be kept constant independent of the diameter of the wheel within reasonable limits. This will enable the grinder to turn out proportionately more work than would be possible with a constant speed motor, and proportionately more work than a belt-driven one with a speed cone giving at the most three changes.

The Napier Iron Works, Nashville, Tenn., had considerable trouble with the working of its furnace during February, reducing the output materially, but things are going along all right now.

BOOK REVIEW.

"Notes on Metallurgical Mill Construction," by W. E. Ingalls. New York. *Engineering & Mining Journal.* 6 x 9 inches. Illustrated. 251 pages. Cloth. Supplied by THE IRON TRADE REVIEW for $2.50.

This work, compiled under the editorship of W. R. Ingalls, is a gathering of notes and articles upon the building and installation of metallurgical plants and machinery. The matter is precisely presented, and includes a sufficient range of practice to be of value in any similar form of building or contracting. Throughout the various stages in the construction of the buildings of which it treats and the machinery it describes, costs of material labor and apparatus are given and in the most valuable form, that of cost per unit.

The compilation from notes permits of each detail of the work being treated separately, no attempt being made at a a balancing of the book in the matter of attention to each subject, but, what is more advantageous to those to whom the book will be useful, the notes are presented in as brief and clear a manner as possible under each individual heading. For example, the costs of earthwork, brick, masonry, concrete mixtures, requirements for concrete, etc., are each treated separately in regard to their practical handling. Earth and foundation work constitute part I of the book, and part II is given to building construction, which is presented in a similar manner with notes on design, lighting, materials and their various qualities with costs of each. Various types of structures, both buildings and their parts, are included in the descriptions. Part III treats of the various classes of ore crushing machinery with details as to capacity, cost and the particular advantages of each, with instructions as to the proper installation from the standpoint of location, foundation and arrangement. Part IV is devoted to dryers and drying, and is treated in the same manner as conveyors and elevators are in part V. The concluding portion of the book has to do with the disposal of tailings of all descriptions in part VI, and in part VII a collection of miscellaneous notes on matters tributary to the subject in hand.

On the face of it, this book should be of material assistance as a reference, its value depending, of course, upon the accuracy of the data contained about which, however, there should be no question. The concise manner in which the facts are arranged will appeal to those interested in costs.

COAL PRICES

Have Effect on Iron Market.—The Mond Gas Undertaking.

Office of THE IRON TRADE REVIEW.
Prince's Chambers, Corporation St.,
Birmingham, Eng., March 1.

Coal prices have been a very material element in the situation during the past few weeks. For this the London demand has been largely responsible. London merchants have been so eager to obtain coal that they have voluntarily offered two to three shillings per ton above the quotations sent out by the pits themselves. This has completely disorganized the market, and naturally tempted colliery owners to put up their prices. Some of the local forges have had great difficulty in continuing operations, and the stuff supplied has in some cases been so bad that the puddlers have required two to three hours more per day to complete their shifts; while the iron has been correspondingly injured in quality. Generally speaking, the manufacturer is in a tight place, with pig iron dearer, coal advancing, and wages higher, while selling prices tend to recede, leaving the margin of profit disagreeably narrow. One ironmaster declares that he has had to pay 16s more for his pig iron, while finished materials, as shown by the wage board ascertainments have increased in price by only 2s per ton. There has been a meeting of the Strip Association to consider the necessity of increasing their prices, owing to the pressure of expensive production, but the question was decided in the negative.

Hints have been given in this correspondence that the great Mond Gas undertaking, which has its headquarters at Dudley Port, was not quite realizing anticipations. Solid evidence to this effect is furnished by the annual meeting which took place yesterday under the presidency of George Macpherson, the chairman of the directors. During the year, they have obtained only 22 installations, and apart from the Mines Drainage commission they were only supplying twenty-four customers at the end of January. The loss on the year was £13,677. The chairman frankly blamed the manufacturers of the district, because they have not shown that willingness to avail themselves of the advantages and economies offered, which might have been expected from business men. As an instance of this saving, a case was cited where the cost of raising steam during six and a half weeks was £29 18s, whereas the Mond gas engine cost only £14. The company has had to erect gas furnaces at its own works on purpose to demonstrate the possibilities of the gas.

The history of the undertaking has proved, what was suspected from the first, that the local ironmasters are too conservative to try even promising experiments, and that, moreover, gas plants, especially gas furnaces, are regarded with distrust. Recent discussions at the South Staffordshire Iron & Steel Institute have abundantly demonstrated this, and at the most recent meeting when Prof. Burstall lectured on the subject, there seemed to be a general agreement that gas was inapplicable to very heavy engines, such as are commonly in use in mills and forges. It has been suggested, however, that the problem might be solved by the introduction of smaller engines working separately for different mills, instead of running several trains of rolls from one large engine, the system which has commonly prevailed in old-fashioned works. It is quite possible that the Mond Gas Co. may be tempted to run large iron works with the object of utilizing their own power.

The annual meeting of the South Staffordshire Ironmasters' Association took place on Thursday last at the Grand Hotel, Birmingham, under the presidency of George Macpherson. The ironmasters represented included Sir George Hingley, Bart, (Noah Hingley & Sons); G. N. Adams (George Adams & Sons); J. T. Cay (Patent Shaft & Axletree Co); J. Whitehouse (John Bagnall & Sons); C. Bunch (B. Bunch & Sons, Walsall); G. H. Pearson (Messrs. Ratcliffe, Oldbury); R. Muras (Messrs. Whitehouse, Deepfields); B. G. Bradley (Messrs. Bradleys' blast furnaces, Darlaston); Col. Patchett, (Shropshire Iron Co., Wellington); Col. Cochrane (Messrs. Cochrane, Dudley); J. F. Pearson (Windmill End furnaces), and G. H. Head (Messrs. Roberts, Ltd., Tipton).

The annual report read by Daniel Jones, secretary, stated that 40 firms were connected with the association, and were generally recognized as representing the iron trade in South Staffordshire and Shropshire. Government departments, the railway companies, and public bodies addressed their communications to the association on any questions generally affecting the iron trade of those districts. It was pointed out that to maintain this status it was necessary that all ironmaking firms in the above districts should become members. Some attention was devoted to various bills pending, as well as to acts recently adopted, of interest to the trade. The rating committee and railway committee were re-appointed, and George Macpherson was unanimously elected chairman for the current year. A call was made to meet the finances of the association, and the proceedings terminated with a vote of thanks to the chairman.

Veteran business men are rather common in the iron trade. A familiar figure was missing this year from the annual meeting of the Birmingham Railway Carriage & Wagon Co. This was Thomas Pickard, for many years chairman of the company. Until well over 90 he presided over the meeting. He has now relinquished the chair in favor of George Beech, but is still on the board, and deputy-chairman. The Hon. F. C. Stanley, a new director of the company, is a son of the Earl of Derby, and served with distinction in the Imperial Yeomanry in South Africa. The company have just declared a dividend of 12½ per cent on ordinary shares, making 10 per cent for the year with a bonus of 5 per cent. Preference shares, 6 per cent.

The sad suicide of Henry Bickerton Whitehouse, furnace manager, of Hurst-hill, is widely regretted by his numerous acquaintances. He had lately been depressed, and had complained to his brother about some worries he had had connected with the management of the furnace.

The largest firms in the trade are generally expressing satisfaction over the good year they have had. The annual report of Vickers, Son & Maxim is due early in March, and it is thought likely that the directors may advise a distribution of 17½ per cent upon ordinary shares. The expenditure on new offices has been paid out of revenue; and if this distribution is made, it will represent 2½ per cent above last year's distribution. The firm is known to have had the busiest and most profitable year for many years past.

Some interest has been aroused among galvanized sheet makers by the report of a new process of distilling spelter zinc, which has been successfully tried in a small way. A more extensive plant is to be laid down in the neighborhood Irvine. The patentee is C. S. Brand, of Dorridge. The smallest relief in this direction would be very valuable, in view of the fancy prices now paid for spelter.

The Wigan Coal & Iron Co. reports a net profit of £93,500 for the past year. It is an increase upon the previous year of £27,000. The company is able to divide 5 per cent instead of 4 per cent the previous year, shareholders thus getting an increase in benefit of £18,000, and carrying forward £3,000.

Steel Corporation's Bookings.—Chairman E. H. Gary of the Untied States Steel Corporation states that the amount of unfilled orders on the company's books at present amount to 8,300,000 tons, compared with 8,489,718 tons on Dec. 31, last. With the exception of the figures announced on Dec. 31, the amount of present tonnages is the largest ever reported by the corporation.

The Chicago, Milwaukee & St. Paul railroad has begun the erection of new shops at Tomah, Wis. The main building is to be 110 x 300 feet.

TAXATION OF MINING.

Discussed at the Canadian Institute—Protest of Malleable Interests.

Toronto, Can., March 8.—As the result of strong protests by the manufacturers of malleable iron, who asserted that their industry would be ruined by the tariff as it stood, further changes have been made. The drawback has been abolished and all malleables, the rate on which was fixed at 25 per cent before, have been made dutiable at 27½ per cent. Malleable iron castings formerly 17½ per cent have been advanced to 20 per cent. The only important change is in the item of sprocket chains, formerly 20 per cent, which have been placed on the free list.

The Temiskaming & Northern Ontario Railway commission has awarded a contract to the Montreal Locomotive Co. for six new locomtives, at an aggregate cost of about $125,000 for delivery before the end of October.

The annual meeting of the Canadian Mining Institute was held in Toronto March 6-8, about 200 being in attendance. The question which excited most interest was the bill now before the Ontario legislature for the taxation of mines, which proposes, in addition to an acreage tax on mineral lands, to levy a tax on the profits of working mines as soon as they amount to over $10,000 per year. The amount of the tax has not yet been announced. A resolution was adopted declaring the tax to be opposed, not only to the mining interests, but to the manufacturing and agricultural interests of the province and asking the government to take time to consider what had been the effect of similar legislation in other countries. A deputation, headed by Geo. H. Smith, president; Col. A. M. Hay, J. E. Hardman, R. W. Leonard and J. M. Clark, waited on Hon. Frank Cochrane, minister of mines, and other members of the government, and presented arguments against the tax. Mr. Cochrane in reply stated that the bill would be passed and that probably the only change would be the remission of the tax upon iron ore smelted in the province.

A statement on the mineral production of Canada for 1906 prepared by the Geological Survey of Canada was presented showing a total production in value of $80,000,048, as compared with $69,525,170 in 1905. The total metallic production was $42,979,629, including iron ore export, 74,778 tons, value $149,177, and pig iron from Canadian ore, 104,660 tons, value $1,724,400. The total production of pig iron in Canada from both Canadian and imported ore amounted to 598,411 tons, as compared with 525,306 tons in 1905, an increase of over 13 per cent in quantity. This represents the output of mine companies operating 15 blast furnaces. The ore charged into the blast furnaces totalled 1,204,473 tons, of which 221,733 tons was Canadian.

A large number of papers were read, including the following relating more particularly to the iron industry: "Iron Mining Possibilities in the Province of Quebec," by Fritz Cickel, M. E., Montreal; "Iron Ores of Canada," Prof. C. K. Leith, Madison University, Wis.; "Supplies and Reserves of Iron Ores," John Birkinbine, M. E., Philadelphia; "Recent Discoveries of Iron in the Torbrook District," W. F. C. Parsons, Londonderry, N. S.; "Electric Furnaces," Dr. A. E. Stansfield, Montreal.

GERMAN TRADE PROSPEROUS.

Cable dispatches from Berlin state that at the meeting of the German Machine Tool Makers' union a committee reported that the fears expressed at the end of 1906, that the iron trade in Germany had reached the high-water mark, were altogether groundless. Another anxiety, much in evidence at the end of last year, that the continuously increased prices would stop business, has found no justification so far, since buyers are more concerned as to the period of delivery than in regard to the fractional increase in value. It was brought out at the meeting that while prices were considerablly higher than at this time last year, the stockholders could not expect the combination to make equivalent profits, as the rise in raw material is still proportionately more than the increased value of the finished products, while the wages bill has continually to be augmented, owing to the enhanced cost of living and the limited number of men available for the work. It was declared that another adverse factor apparent in a small way is the competition of American-made machinery and machine tools, and, if the usual pushing American policy is continued in this direction, the present year, with all its favorable promise, may not prove so satisfactory to the interested parties as 1906.

More Money for Tests.—After two spirited debates on the floor of the house in which party lines disappeared, Representative Dalzell and W. H. Graham of Pennsylvania succeeded in incorporating into the sundry civil bill the recommendations of the bureau of geological survey. When the bill passed the house the first time, Representatives Dalzell and Graham succeeded in increasing the appropriation for the investigation of fuel at St. Louis to $200,000, and the investigation of building material to $100,000. In the senate there was added to the appropriation for the fuel tests $50,000, and the house adopted the senate amendment, making a total of $250,000 for the fuel tests.

STEADY PROGRESS

Being Made at San Francisco.—Unreasonable Union Rules.

San Francisco, March 7.—There has been the greatest activity in San Francisco in all lines of the metal trades, particularly structural steel and reinforcing bars for concrete construction. Most of the buildings left standing after the fire have well under way the necessary repairs, and in the down-town district every available piece of property has a building either in course of construction or projected. So much has been claimed for re-inforced concrete construction that we are now to have an opportunity of testing it under our own peculiar conditions, and engineers and architects seem to have no fear of the results, judging from the large number of buildings now going up. Steel construction still holds its own, however, but in many cases a combination of steel and concrete is being employed with great success.

There is not the slightest doubt in the minds of any of us, that San Francisco will be a greater and better city in the course of a few years. As an example of what energy has been thrown into re-construction work, it may be mentioned that for every 45 minutes of elapsed time since April 18 last, there has been a building permit taken out. Not all of these are for permanent structures, but in the case of temporary buildings, permanent improvements are being planned to be carried through at the first opportunity. It would be hardly fair to the investing public and employers to pass over our re-construction period without some slight mention of the obstacles in the way of carrying on work here, because of the strict rules which the various labor unions have laid down. Eight hours constitute a day's work with Saturday afternoon off. Without any prejudice on the part of the writer, it would seem that some of the rules work very seriously to the disadvantage of the city. One ruling prohibits the use of metal window frames not made in the city, and as a consequence several of the buildings now undergoing repairs or being constructed, are to be left out of the strictly fire-proof class, because our local shops have not the equipment to supply the demand for metal-covered frames.

All of the foundries, machine shops and ship yards are crowded with work and there is an unprecedented demand for machinery of every description. All local representatives of eastern manufacturers of machinery are taking orders every day for deliveries several months ahead, and, though the purchaser strongly objects to waiting so long, it seems out of the question to expect any better deliveries from the east.

Stock Market Prices Reaching Low Ebb.

A general demoralization of prices during the week, causing an excited movement which has greatly resembled a semi-panic, has left the stock market in an extremely feverish condition. Under a continued flood of liquidation, there has been great disorder in the market and the period, in excitement and erratic movement, has rivaled the great liquidation campaign of 1903. The downward movement during the week was interrupted at intervals by sharp rallies which had the effect of moderating the otherwise panicky sentiment. Comparisons have been frequent with the famous year 1903. In this paralleling of the two periods, it is shown that the decline in stocks from the high point in 1906 has already progressed nearly, if not quite as far, as it did in the liquidation three years ago, and it also shows that the present movement, as was that in 1903, is a rich man's liquidation. The essential difference between the two years is that there is no evidence at present of such a falling off in general business as was emphatically presented in 1903. In view of present conditions it is confidently believed in speculative circles that the prices of securities in the recent past had reached an unreasonable level and were held there largely by main force by the market operations of men of a very wealthy class. The present liquidation is attributed largely to this origin and is regarded as an outgrowth of a readjustment of ideas of values as measured by the course of the money market and a recognition of the necessity of a scaling down of the securities involved in sustaining securities at an artificial level in order to effect a redistribution of capital to conform to the requirements presented. Steel stocks have been unusually weak during the period under review. On Monday United States common declined to the lowest of the new year, while the preferred dropped to the lowest since 1905. Toward the end of the week United States Steel common recorded new low prices for the year, but recovered most of this loss before the final close. The common stock in the week showed a net loss of six points. Other industrial net declines were American Car & Foundry common 4 points, American Locomotive common 4¼ points, American Steel Foundries preferred 4 points, Cambria Steel 4¼ points, Colorado Fuel & Iron 7⅛ points, General Electric 8 points, International Steam Pump common 4¾ points, New York Air Brake 9⅞ points, Pressed Steel Car Co. 7¼ points, Pullman 6 points, Republic Iron & Steel common 7 points, and preferred 4½ points, Sloss-Sheffield Steel & Iron common 9½ points, Tennessee Coal & Iron 4½ points, United States Pipe & Foundry 8 points, and Virginia Iron, Coal & Coke 5½ points. The total sales for the week on the New York Exchange amounted to 9,589,100 shares. Wednesday was the wildest day of the year, and sales reached 2,256,300 shares. Call loans ranged from 4 to 6 per cent. The bank statement was unfavorable, showing a loss of nearly $6,500,000 in cash reserve. Loans declined more than $2,000,000.

THE LEADING INDUSTRIAL SECURITIES.

	Closing Quo. Mar. 9	Changes In Week	Date 1907 Ann. Meet.	Stock Outstanding	Dividend Basis	Dividend Being Paid	Dividend Date Last Div. Pay.
Allis-Chalmers	13¼	+ ⅛	Sept.	19,820,000			
Allis-Chalmers pr	32	−2½		16,150,000	7 cum		Feb., 1904
American Can	6¼	− ¾	Feb.	41,233,800			
Am. Can pr	51⅜	−3⅜		41,233,300	7 cum	5 Q.	Jan., 1907
Am. Car and Fdy	39⅛	−4	June 27	30,000,000		½ Q.	Jan., 1907
Am. Car and Fdy pr	109⅜	−2½		30,000,000	7 n. c.	7 Q.	Jan., 1907
American Loc.	68	−4¼	Oct. 5	25,000,000		1¾	Feb., 1907
American Loc. pr.	108¼	−2¼		24,100,000	7 cum	7 Q.	Jan., 1907
American Ship.	74	− ½	Oct. 2	7,600,000	6	1 Q.	Mar. 1907
American Ship. pr.	108¾	....		7,900,000	7 . c.	1¾ Q.	Jan. 1907
Am. Steel Foundries	8	− ½	Oct. 1	15 810,000			
Am. Steel Foundries pr.	38	−4		17,240,000	6 cum		Aug., 1904
Barney & Smith	71	....	June 4	2,000,000	4	4	Ma., 1907
Barney & Smith pr.	135	−3		2,500,000	8 cum	8 Q.	Mar., 1907
Bethlehem Steel	16	−2¾	April 2	14 802,000			
Bethlehem Steel pr.	51	+1		14,908,000	7 n. c.	5 Q.	Feb., 1907
Cambria Steel	39⅜	−4¼	Mar. 19	45,000,000*	6	3 Q.	Feb., 1907
Cambria Iron	47	−1		8,468,000*	4	4 S. A.	Oct., 1906
Chicago Pneumatic Tool	46	....	Feb. 18	6,145,800	4	4 Q.	Jan., 1907
Colorado Fuel	36⅛	−7⅛	Oct. 21	30,132,000			Apr., 1902
Crucible Steel	9	− ¾	Oct. 16	24,578 400			
Crucible Steel pr.	74⅛	−3⅛		24,436,500	7 cum	6	Dec., 1906
Empire Steel	9	+1	Feb. 27	2,281,400			
Empire Steel pr	50	....		2,500,000	6 cum	3 S. A.	uly, 1906
Fay & Egan	95	....	Feb. 19	1,000,000	6	7 Q.	eb., 1907
Fay & Egan pr	128½	....		1,000,000	7 cum	7 Q.	Feb., 1907
General Electric	149½	−8	May 14	63,613,600	8	8 Q.	Jan., 1907
Harbison-Walker	11¾	....	Jan. 21	18,000,000	6		
Harbison-Walker pr.	70	....		9,600,000	6 cum	6 Q.	Jan., 1907
International Pump	30	−4½	June 4	17,762,500		2	Apr., 1905
International Pump pr.	74⅞	−2⅜		11,350,000	6 cum	6 Q.	Feb., 1907
Lackawanna Steel	60	....	Mar. 13	34,971,400			
Lake Sup. Corp	11	−⅜	Oct. 2	40,000,000			
New York Air Brake	124⅜	−9⅜	June 18	10,000,000	8	8 Q.	Jan., 1907
Niles-Bement-Pond	130	....	Feb. 6	5,000,000	6	6 Q.	Mar, 1907
Niles-Bement-Pond pr.	105	....		2,000,000	6 cum	6 Q.	Feb., 1907
Otis Elevator Co.	45	−1	March 18	6,350,300		2 A.	Apr., 1906
Otis Elevator Co. pr.	92	−1		6,308,500	6 n. c.	6 Q.	Jan., 1907
Penn. Steel	66	....	May 13	10,750,000			
Penn Steel pr.	101	−2		16,500,000	7 n. c.	7 S. A.	Apr., 1906
Pittsburg Coal Co.	14	− ⅝	Feb. 11	32,000,000			Nov.
Pittsburg Coal pr.	56	− ⅞		32 000,000	7		Apr., 1905
Pressed Stl Car	41⅜	−7¼	Feb. 20	12,500,000		3	Aug., 1904
Pressed Stl. Car pr.	93	+2		12,500,000	7 n. c.	7 Q.	Feb., 1907
Pullman	162	−6	Oct. 17	100,000,000	8	8 Q.	Feb., 1907
Railway Stl. Spring	47¾	−3½	Mar 7	13,500,000		4 S. A.	Mar., 1907
Railway Stl Spring pr.	98¾	+ ⅛		13,500,000	7 cum	7 Q.	Mar. 1907
Rep Iron & Steel	26	−7	Oct. 9	27,191,000			
Rep. Iron & Steel pr.	94⅜	−4½		20,416,900	7 cum	7 Q.	Apr., 1907
Sloss-Sheffield	57⅛	−9⅜	Mar. 5	10,000,000	5	5 Q.	Oct., 1906
Sloss-Sheffield pr.	100	−3		6,700,000	7 n. .	7 Q.	Jan , 1907
Tenn. Coal & Iron	142½	−4½	May 7	22,553,050	4	4 Q.	Feb., 1907
U. S. Pipe & Fdy.	37	−8	June 26	12,500,000	4	4 Q.	Dec., 1906
U. S. Pipe & Fdy. pr.	82¾	−3⅝		12,500,000	7 n. c.	7 Q.	Dec., 1906
U. S. Steel	37⅞	−6	April 15	508,302,500	2 n. c.	½ Q.	Mar., 1907
U. S. Steel pr.	100¼	−3⅝		360,281,100	7 cum	7 Q.	Feb., 1907
U. S. Steel 5's	96⅛	−2⅛		463,798,000	5	5 A.	
Va. Iron, Coal & Coke	66	−5½	Sept. 17	8,641,600			
Westinghouse Elec.	150	....	July 24	24,998,700*	10	10 Q.	Jan., 1907
West'ghouse Air Brake	156	....	Oct. 1	11,000,000*		22½ Q.	Jan. 1907

Par value of shares, $100, except those starred, $50.

Financial Notes.

The American Car & Foundry Co., in its quarterly statement, for the quarter ending Jan. 31, 1907, shows net earnings of $2,307,282, as compared with $1,008,111 in 1906, or an increase of $1,299,171. The nine months, from May 1 to Jan. 31, show net earnings of $5,744,317, as compared with $2,351,162 in the corresponding period last year, an increase of $3,393,155. The total surplus of the company now amounts to $17,982,411, as against $13,531,596 in 1906, an increase of $4,450,815.

Recent dividend declarations include the Cambria Iron Co., regular semi-annual dividend of 2 per cent, payable April 1; the Railway Steel Spring, regular semi-annual dividend of 2 per cent on common stock, payable March 4; American Car & Foundry, regular quarterly dividend of 1¾ per cent on preferred stock with the regular quarterly dividend of ½ of 1 per cent on the common stock, both payable April 1; American Can Co., regular quarterly dividend of 1¼ per cent on preferred stock, payable April 1; General Electric Co., quarterly dividend of $2 a share.

NEWS FROM MANY INDUSTRIES.

New Buyers:—

The Plume & Atwood Mfg. Co., Waterbury, Conn., has increased its capital stock to $3,000,000.

The Zent Automobile Mfg. Co., Bellefontaine, O., has increased its capital stock from $25,000 to $100,000.

The Buffalo Pattern Works, Buffalo, N. Y., has been organized with a capitalization of $20,000 by Edward Simon and Henry Walthers.

The Model Machinery Co. has been incorporated in Little Rock, Ark., with a capital of $10,000 by Joseph Berg, John J. Baskin and O. M. Straube.

The Sabinski Air Compressor & Vacuum Co. has been incorporated in St. Louis, Mo., with a capital of $12,000, by Charles O. Sabinski and others.

The Manley-Landreth Machine Co., St. Louis, Mo., has been incorporated with a capital of $50,000, by L. E. Manley, Edith Manley and W. H. Landreth.

The Kansas City Structural Steel Co., Kansas City, Mo., has been incorporated with a capital of $500,000 by Howard A. Fitch, C. C. Smith and M. M. Swetman.

The Neosho Foundry & Plow Works, Neosho, Mo., has been organized with a capital of $150,000 by Warren Henton, J. C. Alexander, E. D. Smith and others.

The People Metallic Railway Tie Co., Hillsboro, Tex., has been incorporated with a capital of $100,000 by E. F. Pritchard, W. T. Eldridge and Jonathan Lane.

The Ohio Rail Co., Newark, O., has been incorporated with a capital of $50,000 by L. B. Richards, L. B. Foster, T. J. Costello, H. N. Bernheimer and F. M. Black.

The Potter Mfg. Co., Boston, Mass., has been organized with a capitalization of $50,000 by H. Clark, Medford, Mass.; M. H. Potter, New York, and F. E. Hawkes, Boston.

The Wolfe Machine Co., Buffalo, N. Y., has been incorporated with a capital of $45,000 by C. R. Wyckoff, A. P. Wolfe and J. M. Satterfield to manufacture machinery.

The Ninevah Coal & Coke Co., Greensburg, Pa., has been organized with a capitalization of $100,000 by George F. Huff, Lloyd B. Huff and Julian B. Huff, all of the address given above.

The Chicago Machinery Mfg. Co., 88-92 West Jackson boulevard, Chicago, recently announced an increase in its capital stock from $10,000 to $25,000. The purpose is to increase equipment.

Warden King, Ltd., has been incorporated by James C. King, Louis A. Payette, R. C. McMichael and others as iron founder and machinist, with $1,000,000 capital and head office at Montreal.

J. & W. Jolly, Inc., Holyoke, Mass., have been organized to conduct a machine shop with a capitalization of $90,000 by William J. Jolly, Arthur H. Burgess and William Jolly.

The Lovejoy Co., Cambridge, N. Y., has been incorporated with $100,000 capital by H. H. Lovejoy, L. H. Lovejoy, E. D. Lovejoy and A. S. Rice. Farm tools and implements will be manufactured.

The Conley Frog & Switch Co., Memphis, Tenn., has been formed with an authorized capital of $200,000 by Frank J. Callahan, Benjamin S. Randall, John E. Conley and Donald M. Carter.

The Collins Iron Works, Geneva, N. Y., has been incorporated by L. D. Colins, G. W. Johnson, and J. W. Wilson. The capitalization is $40,000, and boilers, tanks, castings, etc., will be manufactured.

The J. R. Brockman Mfg. Co., St. Louis, Mo., has been organized with a capitalization of $25,000 to make metal pipes, fittings, etc. The incorporators are: J. R. Brockman, Clyde Mettler and Lloyd Holt.

The American Safe Co., Winchester, Va., has been organized with a capitalization of $100,000 by J. M. Kincheloe, Upperville, Va.; H. A. Thompson, Leesburg, Va., and W. O. Ramsburg, Washington, D. C.

The American Ironing Machinery Co., 95 Fifth avenue, Chicago, has increased its capital stock from $5,000 to $10,000. The officers of the concern are: H. C. Grosse, president, and Walter French, secretary and treasurer.

The Foley & Williams Mfg. Co., 48-50 Jackson boulevard, Chicago, has obtained permission from the secretary of state to increase its capitalization from $200,000 to $250,000. The company manufactures sewing machines and supplies.

W. S. B. Pastor, Curtis C. A. Bullock, F. Poirier, Hubert Rainand and Octave Pepin have been incorporated as the Roxton Tool & Mill Co., Ltd., to manufacture tools, with $100,000 capital, and head office at Roxton Pond, Que.

Chalmers & Williams, Inc., Chicago, have organized with a capital of $50,000 to manufacture engines, boilers, furnaces, machinery, etc. The incorporators are G. M. Eckels, J. D. Hood, W. H. Quinlan, and G. Eckels, all of Chicago.

The Knoderer Hot Blast Burner Co., Columbus, O., has been incorporated with a capital stock of $50,000 to manufacture a patent burner for heating furnaces. The incorporators are: L. F. Knoderer, E. F. Arras, P. S. Brindle, T. Learn and A. W. Selby.

The Chesterfield Mfg. Co., New York, has been organized to manufacture tools, machines, apparatus, etc. The capital stock is $30,000, and the incorporators are: William F. Newton, Fred E. Vossnack, 220 Broadway, and Thomas Coyngton, 170 Broadway, all of New York.

The Wolff Truck Mfg. Co., Chicago, has been organized to manufacture and deal in rolling stock and motors. The capital stock of the company is $24,000, and the incorporators are: George W. Manierre, 96 Clark street; Frederick W. Lester and Alvin McElroy.

The Annular Rolling & Truck Corporation, Baltimore, Md., has been organized with a capitalization of $450,000 to manufacture car wheels, car trucks, etc., by S. G. Baker, president of the Baltimore Car Wheel Works, Payson street and Patterson avenue; Daniel Powell, J. P. Baker, H. E. Parkhurst and W. S. Rogers.

The Humphrey Trolley Wheel Co., Monroe, Mich., has been organized to manufacture a newly patented trolley wheel for electric cars. The officers of the company are: Henry L. Humphrey, 371 Chene street, Detroit, president; O. J. Leonard, vice president; A. B. Bragdon, secretary, and N. J. Leonard, treasurer, all of Monroe.

The Independent Bakers Machine Co., Chicago, has been chartered with a capital of $10,000. The company has a factory at 127-147 Fulton street. Martin E. Eggert, the president, says the purpose of the incorporation is to give working capital to permit the gradual enlargement of the plant. The other incorporators are William Schulze and Raymond C. Lyons.

The W. A. Snow Iron Works, 19 Portland street, Boston, Mass., has been incorporated to manufacture stable fittings, weather vanes and ornamental wrought iron work. The capital stock of the company is $40,000, and the incorporators are: William A. Snow, Alvah W. Clark and William F. Crowley. The business has been in existence for over 20 years.

The Curtis Mfg. Co., Decatur, Ill., has been incorporated with a capital of $250,000 to manufacture and construct the Curtis truck, invented by Edward A. Curtis, of that city. It is the intention of the company to secure a site of at least 10 acres of good railroad frontage in Decatur, so that there will be ample room for the future growth of the concern.

The Thomas W. Power Elevator Co., Washington Loan & Trust building, 902 F street N. W., Washington, D. C., has

been incorporated with a capital of $100,000 to manufacture electrical, steam and hydraulic elevators, dynamos, engines and mechanical appliances and apparatus in connection with elevators. The incorporators are: Thomas W. Power, William V. Cox and George Howard.

The Atlantic Tool & Machinery Co., 42 West Jackson boulevard, Chicago, has been incorporated with a capital of $10,000. The firm has been in existence for over a year and the incorporation is to permit the branching out of the business. The firm has been engaged in the manufacture of special tools, dies and jigs. It is the intention of the company to go into the manufacture of air compressors and air-driven machinery.

The General Drop Forging Co., Buffalo, N. Y., has been organized with a capital of $100,000 to take over the plant of the General Railway Signal Co., of that city. The company begins operations immediately and the General Railway Signal Co. will turn its attention to a new plant building at Rochester, which it hopes to occupy in June. Among those interested in the General Drop Forging Co. are: B. G. Hubbel, J. D. Hugh, C. H. Hubbel, R. R. Hefford, H. H. Littell and C. H. Littell. The secretary-treasurer and general manager will be C. H. Littell, who was connected with the General Railway Signal Co. The new company will make a number of improvements to the plant and will do a general drop forging business.

New Construction:—

The Kansas City Iron Mfg. Co. has purchased a site in Oklahoma City, Okla., and will build a foundry and machine shop.

The Hoosier Drill Works, Richmond, Ind., is erecting a new foundry building, and the structure will soon be under roof.

The Standard Foundry Co., Detroit, Mich., has taken out a municipal permit to erect a two-story brick foundry and factory in that city to cost approximately $20,000.

The Thayer Foundry Co., Atchison, Kas., is about to begin the erection of a new pattern shop and to enlarge its machine shop. Improvements will soon be made to the molding room.

The Globe Malleable Iron Co., Syracuse, N. Y., has begun work on an addidition, 80 x 160 feet, to its foundry. The building will be of reinforced concrete and is expected to be in operation by the middle of May.

The American Hoist & Derrick Co., St. Paul, Minn., is planning the erection of a large foundry. The city officials have acted favorably upon the proposition to vacate several streets in order to furnish room for the improvement.

The Marion Machine, Foundry & Supply Co., Marion, Ind., at a recent meeting of the directors, decided to erect a new foundry building, 50 x 132 feet, of fireproof construction. The new addition will be equipped throughout with the latest improved machinery and appliances.

The Kilbourne & Jacobs Mfg. Co., Columbus, O., is preparing plans for the addition of a new building to its plant. The building will be used as an iron and steel storage house. The company has purchased a new 30-horsepower gas engine to be used in its stamping department.

The Wytheville Foundry & Machine Shops, Wytheville, Va., recently incorporated, states that it is equipping a modern foundry and machine shops. The capacity of the foundry will be five tons a day and the concern's specialty will be small castings. The company expects to be in its new building by the latter part of April.

Plans have been posted for the erection of a large manufacturing plant at Bristol, Pa., by the Standard Cast Iron Pipe & Foundry Co. The plant will consist of a two-story brick office building, 50 x 50 feet, three foundries, two storage houses, power house, pattern shop, blacksmith shop, paint house, rope house and stable. With the exception of the office and pattern shop, all the buildings will be one story high.

The Brown & Sharpe Mfg. Co. has purchased the lot on the northeast corner of Desplaines street and Washington boulevard and will erect a building to house its Chicago branch. Plans for the building have not been completed, but it will be either a two or three-story structure. The first floor will be occupied by the Chicago agency and the rest of the building will be rented to machinery firms.

The Goodspeed Mfg. Co., Colorado Springs, Colo., is about to erect a plant in that city for the manufacture of a patent valve and the construction of mining and milling machinery, steam and electric hoists. The company is capitalized at $100,000 with D. F. Minor as president and J. A. Morrison, of Colorado Springs, vice president. William Goodspeed, the inventor of the patent valve, will be connected with the plant.

The Yale & Towne Mfg. Co. has recently awarded to Frank B. Gilbreth, New York, contracts for building extensions to its press cabinet and cabinet lock department at Stamford, Conn. The press shop extension will be one story high, approximately 80 x 156 feet, resting on 40-foot piles, with brick walls and timber roof with saw-tooth skylights. The floor will be of reinforced concrete, designed for a live load of 250 pounds. The cabinet lock department extension will be one story high, 42 x 80 feet, of wood construction with gravel roof and concrete foundation and retaining wall. The work will cost about $40,000 and is to be pushed forward as rapidly as possible after the inception of milder weather. The structure will be the sixth and seven building constructed for the Yale & Towne company by Mr. Gilbreth.

The Cincinnati Iron Store Co., Cincinnati, O., is about to erect a new addition, 113 x 116 feet, to its present warehouse. Although the company only organized its machinery and equipment department in September, 1906, it reports a most prosperous growth in these branches of its business, and preparations are now being made with enlarged facilities to take care of the expanding trade. Its power punching and shearing machinery is in active demand and among the recent contracts in this line secured by the concern has been the equipping of the new plant of the Cincinnati Frog & Switch Co. In keeping pace with its general prosperity, the company has taken up a number of additional agencies for Cincinnati and surrounding territory, including that of the Case Mfg. Co., Long & Allstatter, the Quincy, Manchester, Sargent Co., and the Hamilton Machine Tool Co.

General Industrial Notes:—

The Bell & Howell Co., 90 Illinois street, Chicago, Ill., recently organized, will design and manufacture machinery and hardware specialties.

The Ohio Mfg. Co., which is moving from Upper Sandusky to Columbus, O., will have its new plant in Columbus, with the exception of the machinery, completed by April 1.

The new plant recently erected by the Lebanon Steel Casting Co., Lebanon, Pa., has been put in operation. The plant will be operated under the supervision of Herbert Farrel. The company will manufacture principally crucible steel.

Both the house and senate of the Minnesota state legislature have passed bills authorizing the board of control, if on investigation they find conditions favorable, to establish a factory in connection with the state prison for the manufacture of binders, mowers and rakes.

Work on the construction of the plant of the Seneca Iron & Steel Co. has progressed so rapidly that the company hopes to turn over early in June instead of July, as was planned originally. The company will use the South Buffalo railway to make connections with other lines entering into Buffalo.

A steel building, 200 x 350 feet, to be used as a boiler shop, has recently been erected by the Frick Co., Waynesboro, Pa. Complete equipment has been installed and the best railroad shipping fa-

cilities have been provided for. The output of the foundry has also been increased by 25 per cent.

The East St. Louis Locomotive & Machine shop Co., East St. Louis, Ill., at a recent meeting of the board of directors, elected the following officers: M. M. Stephens, president; Geo. W. Allen, vice president and treasurer; C. H. Huff, second vice president, and H. D. Cleveland, secretary.

S. Cheney & Son, Manlius, N. Y., recently incorporated, state that they have simply taken over the plant and business of the firm of S. Cheney & Son, which has been in business since 1866. The output will be gray iron castings. No additional buildings or equipment will be required at this time.

James Radcliffe & Sons, 12-14 Dewey street, Paterson, N. J., recently incorporated, state that they will do light structural work and repairs. The concern is at present considering the installation of an air plant, a belt-driven hammer for smith shop and a lathe for machine shop. No additions are intended at present.

The Doyle Stove & Furnace Co., 50 State street, Detroit, Mich., recently organized to manufacture hot air furnaces, heaters, gas stoves, etc., states that all its goods are made according to the Doyle new principle of combustion, which is said to be an entirely new way of burning fuel. The company is endeavoring to secure a foundry already equipped, and if it cannot secure this, it may build.

The Bucyrus Steel Castings Co., Bucyrus, O., is about ready to begin operation. The main building of the plant occupies a ground space of 146 x 304 feet. The company has a capital stock of $200,000, all held by Bucyrus people. The directors and officers of the company are: P. J. Carroll, president; F. P. Donnenwirth, vice president; W. A. Blicke, secretary-treasurer; G. Donnenwirth, Dr. John A. Chesney, A. M. Rimer and Jacob Colter.

At the annual meeting of the Crompton & Knowles Loom Works, Worcester, Mass., Feb. 27, the following officers were re-elected: C. H. Hutchins, president; Frank P. Knowles, vice president; Lucius J. Knowles, treasurer, and George F. Hutchins, superintendent. The officers and Dr. Homer Gage, Charles F. Hutchins, George E. Warren, Henry H. Merriam and Charles M. Thayer constitute the board of directors. A substantial increase in business during the past year was reported.

G. A. Doeright has purchased the interests of John Tod, Richard Garlick and W. W. Bonnell in the Falcon Bronze Co., Youngstown, O. The company has been re-organized with the following directors: G. A. Doeright, J. G. Haney, Thomas Parrock, E. E. Miller, C. H. Kennedy and R. H. Doeright. The board organized by the election of G. A. Doeright, president and general manager; Thomas Parrock, vice president; J. G. Haney, secretary; E. E. Miller, treasurer, and R. H. Doeright, superintendent. The company manufactures brass and bronze castings.

The supreme court of New Jersey has handed down a decision dismissing the suit of Andrew H. McNeal against the United States Cast Iron Pipe & Foundry Co. McNeal, who sold his plant in Burlington, N. J., to the company afterward charged the corporation with transacting business without complying with the state laws. He brought suit to set aside the corporation's election of directors, declaring that the stock books were not shown at the meeting. The court decided that the laws were complied with and that the election of directors was legal.

By the purchase of $116,000 of the stock of the Bryant Steel Wheel & Rim Co., Columbus, O., by the Diamond Rubber Co., of Akron, O., the control of the Columbus company passes to the latter. The Bryant Wheel & Rim Co., which manufactures wheels for automobiles and bicycles, will continue to operate in Columbus for a time, but will ultimately be moved to Akron. The business hereafter will be conducted from the Akron office. W. A. Marsh, who has been president and general manager, will retire in a few months, when he expects to go east to enter manufacturing business.

On the presentation of a certificate from W. S. Bosler, assistant United States treasurer, in Philadelphia, showing that $207,000 had been deposited with him as part of the purchase price of the plant of the Diamond State Steel Co., Wilmington, Del., Judge Bradford, in the United States court, at Wilmington, dismissed the rule requiring J. B. Newkirk, the purchaser, to show cause why the terms of sale had not been complied with. Subsequently the court ordered the receivers to turn the property over to George S. Cappelle and John Richardson Jr., as trustees, who will hold it until a new company is organized to take over and re-organize the concern.

The Columbus & Hocking Coal & Iron Co., Columbus, O., operating coal mines, coke ovens, and iron furnaces, through the Bessie-Ferro Silicon Co., and at present installing a brick yard at Glendale, near Straitsville, is about to enter another industry. It is negotiating for the purchase of 100,000 acres of timber land in the mountains of Virginia and expects to put in large mills for the preparation of lumber for market. The company's new 1,500-horsepower power plant at Glendale is about under roof and will be in operation within the next 60 days. It will furnish light and power for all of the company's plants in the vicinity of Straitsville.

Trade Notes:—

The Independent Pneumatic Tool Co., Chicago, Ill., has received a large order for Thor piston air drills and pneumatic hammers from the Wisconsin Engine Co., Corliss, Wis.

The Eleanor Iron Co., manufacturer of muck iron, merchant iron and skelp, has removed its general offices from Tyrone, Pa., to Hollidaysburg, Pa. It is stated that the plant in the latter city is running day and night making muck bars. The finishing department has been closed down for an indefinite period.

The West End Tube Works, McKees Rocks, Pa., manufacturer of welded bedstead and special tubing, has just ended its first year as a producer of this class of work. In August the concern began the manufacture of a special mechanical tubing and reports a great demand for this product. To meet the demands of the rapidly increasing business, it is stated that by July, next, the plant will have been increased to almost twice its present capacity.

The Ashland Fire Brick Co., Ashland, Ky., has booked a number of large orders recently, including several open-hearth furnaces for Gary, Ind.; furnace linings for Goshen, Va.; Ashland, Ky.; Columbus, O.; Hanging Rock, O.; Jackson, O.; Big Stone Gap, Va.; LoMoore, Va.; several stoves for South Chicago, Hanging Rock, O.; cement kilns for Yankton, S. D., and Hildalgo, Mex., in addition to a great many smaller orders. The company has been making a great many improvements to its plant recently, and states that the present prospects of its business have never been excelled.

Fires:—

The Turner Tanning Machinery Co., Peabody, Mass., was partially destroyed by fire Feb. 28. The loss is estimated at $50,000.

The pattern shop of the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., was destroyed by fire, Feb. 27.

The round house of the Boston & Maine railroad, Lawrence, Mass., was partially destroyed by fire March 2. Six locomotives were damaged.

The Kast Copper & Sheet Iron Co. and the brass foundry of Fries & Co., Buffalo, N. Y., were damaged to the extent of $10,000 by fire March 3.

The R. J. Dowe Machine Knife Works, Beloit, Wis., was partially destroyed by fire Feb. 27 with a loss of $10,000. Gaston & Sons steel works, adjoining, was badly damaged, a number of valuable patterns being destroyed.

The Black Hills Foundry, Deadwood, S. D., was destroyed by fire recently, entailing a loss of $25,000; insurance $6,000.